Relationship of Exposure to Heart Failure Discharge Teaching to Readmission Within 30 Days

Becky Ann Pogacar
Marquette University

RELATIONSHIP OF EXPOSURE TO HEART FAILURE DISCHARGE TEACHING TO READMISSION WITHIN 30 DAYS

by

Becky A. Pogacar, MS, RN, NEA-BC

A Dissertation submitted to the Faculty of the Graduate School,
Marquette University,
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy

Milwaukee, Wisconsin

May, 2017

ABSTRACT

RELATIONSHIP OF EXPOSURE TO HEART FAILURE DISCHARGE TEACHING TO READMISSION WITHIN 30 DAYS

Becky A. Pogacar, MS, RN, NEA-BC

Marquette University, 2017

Heart Failure (HF) patients are at increased risk for higher rates of hospital readmission within 30 days. Previous studies have demonstrated educational interventions delivered by nurses reduce readmissions but the relationship of the dose of teaching to HF readmission or ED utilization remains unclear.

A retrospective correlational design framed by the General Outcomes Effectiveness Model was utilized to (1) establish a relationship between the dose of discharge teaching documented by acute care nurses and the outcomes of hospital readmission and ED utilization within 30 days of a previous hospital discharge and (2) identify the teaching components included in an evidence-based education plan essential to discharge preparation.

The sample consisted of 1383 unique HF patients from 4 hospitals and 29 units of a large Midwestern healthcare system. Electronic Health Record (EHR) and billing data were extracted and linear regression and direct entry logistic regression procedures were performed to answer the research questions.

Patients were more likely to be readmitted for every unit increase in the aggregate teaching component dose or for every unit increase in the activity level teaching component dose. Patients were less likely to be readmitted with each additional exposure to sodium restriction teaching. Patients were more likely to experience an ED visit within 30 days with each additional unit of fluid restriction teaching provided and less likely to have an ED visit with each additional unit of diuretic teaching provided. No association was found between the number of discharge teaching components received and hospital readmission or ED utilization within 30 days of discharge. Patient characteristic and clinical conditions did not moderate the relationship between discharge teaching and outcomes.

Although there were conflicting findings, this research adds to the study of nurse dose by utilizing nursing documentation from the EHR to link the nursing care process of discharge teaching to the outcomes of hospital readmission and ED utilization within 30 days of discharge. Further research is needed to clarify the relationship between the type and dose of HF teaching and patient outcomes.

ACKNOWLEDGMENTS

Becky A. Pogacar, MS, RN, NEA-BC

No great accomplishment is achieved without the help and support of others. First of all, I would like to thank my husband Dave, my sons, and my daughter-in-law. Working as a full time professional and completing a doctorate is a daunting task. School work often came before weekend family events. I could not have accomplished this without your love, understanding, support and encouragement.

I also extend my thanks to the members of my committee: Dr. Ronda Hughes, for your guidance throughout the proposal process; Dr. Marianne Weiss, for your extensive knowledge of discharge teaching and the discharge process and for your guidance as I finished my dissertation; Dr. Linda Piacentine for your knowledge of acute care nursing and thorough review; and Dr. Singh, for your advice and statistical support. The gifts of your time and talents have contributed to my ability to think critically about problems I will solve in research and practice throughout the remainder of my career.

I thank my colleagues Mary Beth Kingston and Dr. Deborah Gentile for their continual feedback, advice, and encouragement when my energy started to wane. I thank my fellow doctoral students who have so generously given support along the way. It is because of you that I knew I could accomplish this achievement. Finally, I wish to thank Dr. Randall Lambrecht and the Aurora Research Institute for the resources to complete this study.

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

An estimated 6.5 million Americans over the age of 20 have Heart Failure (HF) (Benjamin, et al., 2017)and HF is the most common reason for hospital admission of patients 65 and older (Hines, Barrett, Jiang, & Steiner, 2014). The national average rate of HF readmission within 30 days of discharge is 22.0% (Centers for Medicare and Medicaid Services, 2015). This rate of hospitalization is concerning as inpatients have an increased risk of functional decline, repeat hospitalization, and death post discharge (Barnes et al., 2013; Curtis et al., 2009; Wong & Miller, 2008). Although the adjusted rates of HF readmission within 30 days have declined 9.7% over the last decade (Krumholz, Normand, & Wang, 2014), room for improvement remains.

HF readmission is costly. Thirty-day episode of care costs have been reported to be 78.9% higher for readmitted HF patients than for those patients who have not been readmitted (Hockenberry, Burgess, Glasgow, Vaughan-Sarrazin, & Kaboli, 2013). This increased cost is an issue for organizations due to the Affordable Care Act Hospital Readmission Reduction Program which reduces hospital Diagnostic Related Group (DRG) payment for excessive HF readmissions (Centers for Medicare and Medicaid Services, 2012). This program allows for payment penalty caps up to 2% (Centers for Medicare and Medicaid Services, 2012), compounding losses from non-payment for readmissions.

Hospitals determined to improve the care of HF patients and reduce the risk of potential Centers for Medicaid and Medicare Services (CMS) penalties have introduced transitional care management programs to reduce hospital readmission. In a meta-analysis of 35 outpatient care management program studies, the interventions that were most commonly included as program components were patient education, symptom monitoring by study personnel and by patients themselves, and medication adherence strategies (Wakefield, Boran, Groves, & Conn, 2013). The interventions in these studies were primary delivered by nurses. Treatment groups in the analysis had significantly lower readmission rates than the control subjects (*ES* = 0.157, *p* = <.01). Limitations to the meta-analysis were incomplete descriptions of the interventions provided (including educational content) and/or data (sample size, means, and standard deviations) necessary to evaluate effects which would have allowed for determination of the program components critical to improving patient outcomes.

Publicly reported process measures which were designed to standardize elements of HF teaching while in the hospital were retired by the Joint Commission in 2015 (Federal Register, 2014). Prior to this, The Joint Commission HF-1 core measure required the provision of written HF instructions on activity level, diet, discharge medications, symptom management, follow-up appointments, and weight monitoring to HF patients prior to discharge (The Joint Commission, 2014). Several studies were conducted to evaluate the HF-1 core measure including an impact study, which determined the completion of the core measure was not associated with a decreased probability of readmission (CMS, 2015).

Research has demonstrated an association between HF management teaching by a nurse and (1) adoption of appropriate HF patient self-care behaviors (such as adherence to dietary recommendations, weight monitoring, and recognition of worsening signs of HF) (Kommuri, Johnson, & Koelling, 2012; Riegel et al., 2006; White, Garbez, Carrol, Brinker, & Howie-Esquivel, 2013); and (2) a decreased incidence of readmission (Coleman, Parry, Chalmers, & Sung-joon, 2006; Naylor et al., 2013; Nielsen et al., 2008; White, S., 2014). Additionally, an increase in the quality of inpatient discharge teaching has been linked to an increase in the patient's perceived readiness for discharge; which then has been associated with a decrease in the odds of Emergency Department (ED) utilization post discharge (Weiss, Yakusheva, & Bobay, 2011).

Inpatient readmission reduction programs operated by nurses have generally focused on the delivery of evidence-based interventions and on improving the transition to home. Program evaluation methods published for these studies vary from descriptive quality improvement designs to more rigorous research designs. Six hospital readmission reduction programs are described below.

The Transforming Care at the Bedside Program Guide to Improve HF Transitions (Nielsen et al., 2008) recommended a standardized assessment upon admission for post-discharge needs, enhanced HF teaching and learning, patient and family centered hand-off communication, and post-acute follow-up by a home health nurse or a physician visit within 48 hours after discharge. Two hospital program evaluation studies demonstrated a decreased rate of readmission over the course of the data collection period at the intervention sites.

The Transitional Care Model has been demonstrated to significantly reduce hospital readmission in at risk populations (Naylor et al., 2013). The essential elements of the Transitional Care Model, included but were not limited to, care coordination by an advanced practice nurse (APN), an in hospital assessment and development of an evidenced based plan of care, home visits and telephone follow up. The APNs were responsible for teaching patients and their families and engaging them in their self-care. The intervention group was able to demonstrate fewer readmissions than the control group (p = .04) in 3 months post enrollment.

The Care Transitions Intervention (Coleman et al., 2006) was tested in a randomized controlled trial to determine if the intervention bundle could reduce readmission rates in patients 65 years or older with at least one of eleven diagnosis, including HF. The care transition intervention bundle consisted of four "pillars" including (1) provision of medication self-management assistance; (2) a patient owned personal health record; (3) physician follow-up; and (4) instruction on symptom monitoring and response. Nurse transitions coaches were APNs who facilitated the patient's role in their own self-management regardless of setting. The intervention was initiated with a meeting in the hospital prior to discharge and contact was made again in the home setting 48 to 72 hours after discharge. Three additional contacts were planned within the 28-day post-discharge period. Of the 360 patients included in the intervention group, 86% received at least one home visit and a telephone call. In the analysis, the intervention group had a significantly lower readmission rate than the control group at 30 days (p = .05) and at 90 days (p = .04). The difference in readmission rates equated to a

significant decrease in mean hospital costs for the intervention patients at 180 days (p = .05).

Project RED (Jack et al., 2009) was a randomized controlled trial funded by the Agency for Healthcare Research and Quality and the National Heart, Lung, and Blood Institutes of Health to reengineer the hospital discharge process with the objective of reducing hospital readmission in a general medical population who were discharged to home. In this study, a nurse discharge advocate was responsible for discharge education and for creating a post-discharge plan of care. The patient was contacted two to four days after discharge by a pharmacist to reinforce medication teaching. The intervention required approximately 1.5 hours of nursing time and 30 minutes of pharmacist time per patient. Participants in the intervention group had a significantly lower readmission rate than those in the study group at 30 days post-discharge (p = .03).

The Better Outcomes for Older Adults Through Safe Transitions (BOOST) (Hansen et al., 2013) program focused on improving care transitions for patients age 65 or greater with heart failure and/or other chronic conditions. The model consisted of eight essential elements to improve the discharge process including standardized discharge pathways with self-management instructions. A quality improvement project was conducted with pre/post implementation measurement of 30 day readmission rates for intervention units and site matched control units at eleven hospitals. This project was conducted without addition of resources at the participating sites. An absolute reduction of readmission rate of 2% was achieved by the BOOST units as compared to the control units (p = .05).

The American College of Cardiology has provided evidenced-based resources and tools aimed at reducing cardiovascular related hospital readmissions (American College of Cardiology, 2016). This initiative focused on three interventions: follow-up with a physician or cardiac rehabilitation within 1 week of discharge, optimal medication management, and early detection of symptoms worsening. Moderate improvement in the readmission rate was reported by 43% of hospitals participating in the initiative. These programs demonstrate educational interventions delivered by nurses reduce readmissions but the relationship of the dose of teaching to HF readmission or ED utilization has not been examined.

Provision of HF Discharge Teaching Within the Context of the Inpatient Unit

Patients with HF present to the hospital with hypotension or hypertension and have symptoms of cardiac congestion such as dyspnea, jugular venous distension, and edema (Gheorghiade, Vaduganathan, Fonarow, & Bonow, 2013). Since inpatient mortality for hospitalized heart failure patients is relatively low at 2-7%, (Gheorghiade et al., 2013), most patients are admitted to and discharged from cardiac or other non-intensive care units. The Heart Failure Society of America (HFSA) Comprehensive Heart Failure Practice Guideline (Yancy et al., 2013) views hospitalization as an opportune time to reinforce self-care education, develop an emergency plan of care, and reinforce adherence. Cardiac self-care education is complex and while provision by a nurse specializing in HF is ideal, HF education often occurs on medical or medical-surgical units by clinical nurses who do not specialize in HF (Kociol et al., 2012).

Delivery of patient education during the course of care on the Medical-Surgical units may be problematic. Nursing units may differ in staffing and that variation may influence the ability to provide HF discharge teaching (Giuliano, Danesh, & Funk, 2016; Weiss et al., 2011). Important patient educational needs assessments may be missed and patient education provided informally by the nurse during the course of care may not be documented (Cook et al., 2008). Nurses may also prioritize basic tasks over the education of patients and their family during their busy shift (Frank-Bader, Beltran, & Dojlidko, 2011; Kalisch, Landstrom, & Williams, 2009).

While nurses may be challenged to meet the educational needs of HF patients during hospitalization, they have been given a key role in discharge preparation. All hospital readmission reduction programs which have been implemented to reduce HF readmission have patient education as a key component and nurses maintain the primary responsibility for discharge teaching in the hospital. This accountability intensifies the need for nurses to examine the discharge teaching process.

Statement of the Problem

Heart failure patients are at increased risk for higher rates of ED use (Hasegawa, Tsugawa, Camargo, & Brown, 2014; Hugli, Braun, Kim, Pelletier, & Camargo Jr, 2005) or hospital readmission within 30 days (Hines, Barrett, Jiang, & Steiner, 2014) than patients with other conditions. Organizations that experience higher than expected rates of readmission of HF patients are subject to payment penalties. Educational interventions delivered by nurses can reduce these readmissions.

Nurses experience variation in HF patient characteristics, health literacy and acuity when providing HF teaching to patients within the context of the hospital and nursing unit. These patient and unit factors may impede or enhance the provision of education during the HF patients' hospitalization. How nurses adjust the teaching content and dose of HF discharge teaching in these situations remains unclear.

Previous research examining the effectiveness of HF discharge teaching has focused on compliance to the completion of core measures. Other HF focused studies have explored either the teaching method utilized or the time spent teaching. This study will add to nursing knowledge by utilizing patient level electronic health record data to describe the content and dose of teaching exposure and the relationship they have to hospital readmission of HF patients while controlling for patient characteristics, clinical condition factors, hospital and unit type effects, inpatient pharmacy teaching and transitional care. Interactions between patient characteristic and clinical condition factors and the discharge teaching variables will be explored. The results of this study will be of interest to nurses in search of methods to improve HF discharge teaching efficacy and quality of care.

The Purpose and Aims of the Study

The purposes of this study are to: (a) describe the association between the dose of HF teaching documented in the hospital and the outcome of hospital readmission or ED utilization within 30 days, after controlling for clinical condition factors (including but not limited to functional capacity and respiratory pattern), patient characteristics, unit type and hospital effects, inpatient teaching by a pharmacist, and transitional care; (b)

examine whether clinical condition, and patient characteristics moderate the relationship between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days of discharge after controlling for clinical condition factors, patient characteristics, unit type and hospital effects, inpatient teaching by a pharmacist, and transitional care; (c) explore the relationship between the dose of the seven hospital required HF discharge teaching components included in the HF teaching plan and hospital readmission or ED utilization within 30 days after controlling for clinical condition factors, patient characteristics, unit type and hospital effects, inpatient teaching by a pharmacist, and transitional care; and (d) identify the number of HF teaching components needed to reduce the risk of hospital readmission or ED utilization within 30 days of hospital discharge after controlling for clinical condition factors, patient characteristics, unit type and hospital effects, inpatient teaching by a pharmacist, and transitional care , and (e) identify which components of the HF teaching plan, when provided together, are associated with a decreased probability of hospital readmission or ED utilization within 30 days.

Significance to Vulnerable Populations and Health Systems Serving Vulnerable Populations

HF is a life-limiting diagnosis. HF patients are more likely to experience recurrent hospitalization after their first acute care episode and in the last 18 months of life (Chun et al., 2012). An estimated 5.7 million people in the United States have heart failure, and although survival has improved over time, about half of those people will die within 5 years of diagnosis (Roger et al., 2012). The total direct and indirect cost of care for patients with cardiovascular disease is estimated at $297.7 billion nationally, more

than all other diagnostic groups (Roger et al., 2012). Heart failure (HF) patients account for approximately 1.02 million United States hospital discharges annually (Go et al., 2013) and are more likely than patients with other chronic diseases to experience a hospital readmission within 30 days of discharge (Hines, Barrett, Jiang, & Steiner, 2014; Riggs & Madigan, 2012; Rosen et al., 2014). They may also experience an increased incidence of ED visits due to factors such as minority race or ethnicity and lower socioeconomic status (Hasegawa et al., 2014).

HF patients present to the hospital with worsening symptoms and increasingly complex clinical and social issues which influence patient outcomes. HF patients with a higher co-morbidity burden who live in neighborhoods with low median household incomes and those receiving Medicaid are at greater risk of hospital readmission (Foraker et al., 2011; McIlvennan & Allen, 2014). Hospitals in economically depressed areas serving the Medicaid or uninsured patient might seem at greater risk for readmission penalties. However, Ross et al. (2012) found hospitals that care for predominately poor, vulnerable patients have similar readmission outcomes to other hospitals within the same region, suggesting that safety-net hospitals can achieve similar outcomes to those that do not care for a large proportion of Medicaid patients. This finding heightens the importance of understanding how the content and dose of discharge teaching can improve patient care outcomes and reduce 30-day episode costs of care.

Significance to Nursing

Nurses play an essential role in the prevention of hospital readmissions through early identification of complications, prevention of functional decline, estimation of

readmission risk, provision of effective discharge teaching, and coordination of appropriate post-discharge referrals (Holland & Bowles, 2012; McHugh & Ma, 2013; Sochalski et al., 2009; Weiss et al., 2015; Weiss et al., 2011). Since HF patients and their family members are responsible for managing their own self-care between visits to their primary care provider, nurses must assure patients and their families have the necessary knowledge to manage their heart failure as a component of the discharge plan (Riegel et al., 2009).

In response to the increased incidence of hospital readmission of HF patients, peer review and professional organizations have attempted to prescribe the content and method of delivery of patient education to HF patients (Heart Failure Society of America, 2010a; Jessup et al., 2009; The Joint Commission, 2014). Attempts to educate HF patients as if they were a homogenous patient population have not been effective, as evidenced by the high readmission rate experienced across the nation. It is important to better understand the teaching components which are critical to improving HF self-care management during the 30-day post discharge period. Symptomatic patients with the knowledge to adhere to treatment and quickly recognize and react to clinical symptoms have been demonstrated to have a 56% reduction in mortality, Emergency Department (ED) use, and hospital readmission (Lee, Moser, Lennie, & Riegel, 2011).

Significance to Nursing Research

Studies examining HF discharge teaching have been focused on the completion of educational components which were required for quality reporting (CMS, 2015; Jensen, 2011; Mueller, Lipsitz, & Hicks, 2013; VanSuch, Naessens, Stroebel, Huddleston, & Williams, 2006) or have evaluated the outcomes of teaching provided by HF nurse

educators (Koelling, Johnson, Cody, & Aaronson, 2005; White, et al., 2013). This study contributes to the science of patient education and discharge teaching by describing which HF educational components are critical to the avoidance of ED visits or a readmission within 30 days of discharge and what frequency of teaching exposure is necessary to achieve the best outcomes for patients hospitalized with HF.

Since data will be extracted retrospectively from the EHR documentation into a comma separated values (CSV) file which can then be exported into statistical software, the findings will illustrate the frequency of documented evidence-based assessments and HF teaching provided by nurses. This study may also determine the critical teaching components which are necessary to avoid hospital readmission, ensuring the nurse is utilizing their limited discharge teaching time effectively. Finally, the study may provide insight into the relationships between patient characteristics, discharge teaching, and readmission outcomes.

CHAPTER 2

REVIEW OF THE LITERATURE

Chapter two contains a review of the literature relevant to the factors which influence hospital readmission of Heart Failure (HF) patients. These include exposure to discharge teaching within the context of the unit and hospital, HF patient characteristics, and barriers to learning. Components of HF education will be described and gaps in the literature will be summarized. An overview of the philosophical underpinnings and conceptual framework which inform the variable selection in this study will be reviewed.

HF Discharge Teaching

Discharge teaching is the provision of self-management education which addresses the patient's anticipated problems post-discharge (Lorig & Holman, 2003). Nurses have the most knowledge of the patient's discharge needs and are critical to the discharge preparation process (Nosbusch, Weiss, & Bobay, 2010). The findings of a meta-analysis of nineteen randomized controlled trials of HF management programs have demonstrated nurse-driven pre-discharge teaching interventions contribute to reduced hospital readmission (Lambrinou, Kalogirou, Lamnisos, & Sourtzi, 2012).

Transfer of learning and consequent adoption of self-care interventions may be influenced by inpatient HF teaching. Kommuri, Johnson, and Koelling (2012) conducted a randomized controlled trial to determine changes in HF patient knowledge after a one-hour HF teaching session provided by a nurse educator prior to discharge compared to

usual discharge care. The pre-intervention baseline assessment of knowledge was similar between the control and study groups. HF patients in the study group had significantly higher scores on the 3 month post-education assessment than patients in the control group (p = .01). This increased knowledge transferred to demonstration of adherence to self-care behaviors including daily weight monitoring, dietary and fluid restriction compliance, and the ability to verbalize a plan for what to do when symptoms worsened. Patients who avoided readmission to the hospital within 6 months of discharge were found to have significantly higher scores on the knowledge assessment.

National standards have been developed to engage patients and their family in discharge planning processes, including the education process, with the goal of reducing hospital readmission. The IDEAL discharge planning handbook (June 2013) advises nurses to provide patient education in limited amounts throughout the hospital stay and to repeat key pieces of information. It also recommends nurses evaluate patient understanding by having them repeat the instruction back in their own words.

The Institute of Health Improvement (IHI) and the Robert Wood Johnson Foundation partnered to create a framework for improvement on medical-surgical units titled Transforming Care at the Bedside (TCAB). This initiative was designed to engage clinical nurses in improving patient care and the work environment on their unit. The TCAB program report (RWJF, 2011) identified nine units focused on improving the discharge process with the goal of reducing hospital readmissions. Projects were conducted between 2006 and 2007 and the units demonstrated a 2% reduction in readmission rate.

The TCAB Program Guide to Improve HF Transitions (Nielsen et al., 2008) was one tool specifically designed to provide guidance to clinical nurses on the safe transition of HF patients to home. Strategies to enhance discharge teaching and learning included: (1) identifying the learner or learners who may not be the patient; (2) identifying how patients learn and providing resources as appropriate; (3) using plain language and breaking down education into segments; and (4) utilizing the teach back method daily to assess the learners understanding. At one TCAB site, HF instruction was provided by inpatient nurses while hospitalized, continued over the transition period by home care nurses within two days of discharge, and completed by Advance Practice Nurses (APNs) seven days post-discharge. Process measures were defined to evaluate the effectiveness of the teach-back method of assessing patient understanding. Patients could correctly answer teach back questions greater than 80% of the time and their reported rate of satisfaction with the adequacy of their discharge instruction was greater than 90%. Readmission rate was not reported (Nielsen et al., 2008).

Despite shorter patient lengths of stay and increasing workloads, inpatient nurses maintain responsibility for providing the majority of patient education during hospitalization. HF discharge teaching may be provided by one or several nurses caring for the patient. Time constraints due to workload or time spent on non-nursing tasks are among the environmental barriers to patient education (Bergh, Friberg, Persson, & Dahlborg-Lyckhage, 2014; Frank-Bader et al., 2011). Errors of omission occur as nurses prioritize multiple demands within their work day, potentially impacting their ability to complete basic nursing tasks and execute a comprehensive discharge plan. Nurses have reported errors of omission related to care planning, teaching, and care coordination

during provision of inpatient care (Kalisch et al., 2009) and these occurrences of missed care have been associated with HF readmission (Brooks Carthon, Lasater, Sloane, & Kutney-Lee, 2015).

Nurses may either omit discharge teaching interventions or reduce the amount of teaching provided based on competing priorities and this variation in the dose of teaching may impact outcomes of care. Intervention dose has been studied in the ambulatory setting. Telephone-delivered patient counseling was provided to adult patients with type 2 diabetes (Shirey, Ebright, & McDaniel, 2013). The educational intervention included a maximum of twenty-seven telephone calls over an 18-month period compared to usual care consisting of provision of standard information on diabetes self-management. The intervention dose was defined as the number of calls completed during the study period. The telephone intervention was categorized into low (0-11 calls), medium (12-20 calls) and high (21 or more calls) doses. After adjusting for confounding variables, the high dose category was significantly associated with weight loss in the intervention group.

In addition to variation in the amount of teaching due to errors of omission, patients on medical-surgical units may also be instructed by nurses with their own knowledge deficits related to HF educational content (Sterne, Grossman, Migliardi, & Swallow, 2014). This lack of knowledge may impact the quality of discharge teaching provided. Nurses report they spend an average of less than 15 minutes on discharge teaching, but the frequency of discharge teaching and amount of time spent teaching increases when the nurse is comfortable with the educational content (Albert et al., 2011). This could explain why patient discharge from a cardiac specialty unit has been

associated with lower HF readmission rates (Jensen, 2011). Nurses comfortable with the content could be adjusting the amount, type, and depth of content to patient need.

Organizational Characteristics and Exposure to Discharge Teaching

Unmeasured unit or hospital level variables may impact patient education provided to HF patients. Studies have quantitatively linked components of unit and hospital structure to hospital readmission. McHugh & Ma (2013) described a relationship between hospital nurse staffing levels, nursing work environment, nurse education, and 30-day readmissions among Medicare patients with HF, acute MI, and pneumonia. An increase in one patient in the nurse's workload was associated with a 7% increase in the odds of readmission for HF patients, 6% increase for pneumonia patients, and a 9% increase for myocardial infarction patients. The presence of a better work environment was associated with a 7% decrease in the odds of readmission for HF patients, a 6% decrease for myocardial infarction patients, and a 10% decrease for pneumonia patients.

Giuliano, Danesh, and Funk (2016) performed a secondary analysis utilizing data from 661 hospitals specializing in cardiac surgery and cardiac care listed in the US News and World Report Best Hospitals survey. The study examined the relationship between a hospital level nurse staffing index (total number of RN FTEs / adjusted average daily patient census) and the CMS HF readmission metric. The low nurse staffing index hospital group had a statistically higher excess readmission ratio. In another large database study of 577 hospitals in California, Massachusetts, and New York, increased HF readmission was associated with: (1) a higher number of admissions per bed; (2)

teaching status; (3) poor nurse communication with patients; (4) lower nurse staffing; and (5) a decreased percentage of patients reporting they had received information on how to care for themselves after discharge (Stamp, Flanagan, Gregas, & Shindul-Rothschild, 2014).

Factors which have been demonstrated to influence RN workload and subsequent delivery of nursing care are the use of RN monthly overtime hours (Capuano, Bokovoy, Hitchings, & Houser, 2005; Weiss et al., 2011) and admission/discharge/and transfer (ADT) activity (Needleman et al., 2011). While nurses perceive working either 8 or 12 hours shifts do not have an effect on patient outcomes (Stone et al., 2006), nurses report frequent shift changes due to variation of a mixture of shifts and (Kalisch, Begeny, & Anderson, 2008; Krichbaum et al., 2010) working more than 13 hour shifts (Stimpfel, Lake, & Barton, 2013) have a negative effect on the continuity of patient care, quality of care, and teamwork on the unit.

Nursing characteristics have also been demonstrated to impact patient outcomes. Hospitals with higher levels of Baccalaureate prepared nurses have been demonstrated to have lower mortality rates and failure to rescue (Aiken, Cimiotti, Sloane, Smith, & Neff, 2011; Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Estabrooks, Midodzi, Cummings, Ricker, & Giovannetti, 2005). Yakusheva, Lindrooth, and Weiss (2014a) established a relationship between the dose of BSN proportion provided to patients and improved outcomes. Patients who had received > 80% of their care by a BSN prepared nurse demonstrated 18.7% lower odds of readmission and a 1.9% shorter length of stay. An increase in 10% of patient level BSN dose was associated with a 10.9% decreased odds of mortality while hospitalized.

The dose of nursing care provided to the patient by the nurse may be influenced by unit level staffing, workload, and nursing characteristic factors. Manojlovich, Sidani, Covell, & Antonakos (2011) conceptualized nurse dose to consist of an active ingredient (education, experience, and skill mix) and intensity (full-time employees, RN: patient ratio, RN hours per patient day). In a study to determine the validity of the theoretical construct, staffing variables were converted to attributes of nurse dose and an analysis was conducted to explore the association between these variables and MRSA infection and fall rate. In the regression models, active ingredient (education, experience, skill mix) and intensity (FTE, RN: patient ratio, RN-HPPD) had a strong inverse association to the outcomes.

Organizational and structural components of hospitals and nursing units impact the provision of patient care and subsequent patient outcomes. Studies which have examined the relationship between specific aspects of nurse dose have demonstrated an association between nurse dose and patient outcomes at the unit and patient level. Intervention dose (defined as telephone intervention frequency) delivered in an outpatient counseling program has been associated with improvement in an outcome requiring behavioral change. Little is known about how the dose of HF teaching intervention provided to HF patients on the inpatient unit contributes to readmission outcomes.

HF Educational Components

The components of HF teaching described in this chapter include (a) causes of HF and what the patient will need to know immediately post-discharge; (b) weight monitoring; (c) activity level; (d) dietary restrictions; (e) understanding the medication regime; (f) plan for follow-up post-discharge; and (g) verbalization of what to do if

symptoms worsen. These HF teaching components are recommended by the American College of Cardiology Foundation/American Heart Association (ACCF/AHA) (Yancy et al., 2013) and the Heart Failure Society of America (HFSA) (Heart Failure Society of America, 2010b) guidelines. The ACCF and the AHA were both founded by cardiologists with the purpose of improving cardiovascular health through education, research, quality care, and health policy (American College of Cardiology, 2017; American Heart Association, 2017). The HFSA serves as a forum for interprofessional education, HF research and patient care (Heart Failure Society of America, 2017).

Until 2015, the provision of this recommended educational content was included as a publicly reported core measure by The Joint Commission and utilized as an indicator of quality care delivery to HF patients (The Joint Commission, 2014). The HF-1 core measure specified this educational content should be provided to patients in written form at time of a HF discharge. The measure was removed from quality care measure reporting and is now a voluntary electronic quality measure (Federal Register, 2014).

Inconsistency exists between the peer review guidelines regarding the amount of content necessary. The ACCF/AHA recommends the inclusion of HF education, self-care, emergency plans, and medication adherence at hospital discharge (Yancy et al., 2013). HFSA guidelines recommend that essential instruction on HF and the goals of treatment, medication regime and the follow-up regime be covered during hospitalization and reinforced 1-2 weeks post-discharge (Heart Failure Society of America, 2010b).

Causes of HF and Focus of Education. The Comprehensive Heart Failure Guideline of the Heart Failure Society of American (HFSA) advises instruction on the

causes of HF. This includes the definition of the disease, the link between the disease and symptoms experienced, and the treatment for these symptoms (Heart Failure Society of America, 2010b). The focus of education is action oriented, focused on what the HF patient will "*need to do rather than on what they will need to know*" and individualized to their current level of knowledge and perceived barriers (Heart Failure Society of America, 2010b, pp. e99-100). Intensity of education should increase based on assessment of worsening HF progression and/or inability to adhere to the treatment plan, and the content should be covered more than once (Heart Failure Society of America, 2010b; Jessup et al., 2009).

Weight monitoring. Fluid related weight gain is most commonly due to non-adherence to medication regime, diet, drug interactions, or excessive fluid intake. However, it may also indicate worsening cardiac failure due to low cardiac output or renal insufficiency (Adams et al., 2006). The HFSA guidelines recommend daily weight monitoring for the purpose of assessing the presence of fluid overload (Heart Failure Society of America, 2010a). Although daily weights are recommended, adherence to weight monitoring at least 3 times per week and knowledge of how to cope with weight gain has been associated with a decreased incidence of hospitalization (Wang et al., 2014).

Activity level. Patients discharged from the hospital with an acute exacerbation of their HF are encouraged to participate in light activity to prevent the effects of deconditioning (Jessup et al., 2009). Exercise training is suggested with the goal of attaining the recommended 30 minutes of exercise 5 days per week (Heart Failure

Society of America, 2010a). The relationship of inactivity and resultant functional decline to hospital readmission is covered later in this chapter.

Diet. Instructional content centered on diet and nutrition are an important component of the HF patient's educational plan due to the negative effects of co-morbid conditions such as diabetes, obesity, cachexia, and hypertension on HF prognosis and symptom management. The HFSA guideline recommends the inclusion of sodium restriction content as well as carbohydrate or caloric reduction for patients with obesity, dyslipidemia, or diabetes and nutritional supplementation for cardiac cachexia (Heart Failure Society of America, 2010a). Patients and caregivers may find adherence to the cardiac diet challenging after discharge and require more intensive guidance (Blair, Volpe, & Aggarwal, 2014). Diet self-care skill training during hospitalization is limited to the ability to sort foods into high or low sodium categories (Heart Failure Society of America, 2010b).

Medications. The skills necessary for HF medication self-management are patient understanding and verbalization of each medication name, dose, and purpose (Heart Failure Society of America, 2010b). However, medication education alone may not be effective in preventing non-adherence to the treatment plan (Molloy, O'Carroll, Witham, & McMurdo, 2012). Adherence to the treatment plan may be complicated by problems with provider communication, lack of symptoms which cue the need for medication, physical or mental impairment, a complex medication regime or side effects, low health literacy, or resource issues (Ho, Bryson, & Rumsfeld, 2009). These factors should be considered when establishing the education plan.

Follow-up. Monitoring and reinforcement of education is recommended within one week of hospital discharge (Heart Failure Society of America, 2010b). Referral to a HF disease management program is recommended. Follow-up should continue over the course of 3 to 6 months until the HF patient can independently adhere to their treatment plan, demonstrate improved functional capacity and until symptoms are stabilized (Adams et al., 2006; Heart Failure Society of America, 2010b). Additionally, follow-up with a familiar physician in the first month of discharge reduces the risk of unplanned hospital readmission (McAlister et al., 2013).

Symptom worsening. Instruction on the signs of decompensated heart failure is essential to early recognition of HF exacerbation. Symptom monitoring has been identified as a predictor of the adequacy of self-care management (Lee et al., 2015). Patients should be able to verbalize recognition of increased shortness of breath with rest or activity, weight gain, edema, or fatigue. An action plan on how to change their diet, fluid intake, or diuretics should be prepared. Most importantly, patients should verbalize how and when to call their provider (Heart Failure Society of America, 2010b).

Patient Characteristics and Risk for Readmission

Examination of patient characteristics associated with readmission allows for a better understanding of which factors may increase risk for hospital readmission. These risk factors may also influence the strength of the relationship between discharge teaching and hospital readmission. Teaching dose may be adjusted in response to patient need. Risk prediction models which include social and functional factors as well as co-morbidity and utilization factors appear to perform better than other comparable

prediction models (Amarasingham et al., 2010; Kansagara et al., 2011). For the purpose of this review, patient characteristics associated with an increased risk of readmission are categorized into socio-demographic, health literacy, non-modifiable barriers to learning, and clinical condition variables. How these factors contribute to readmission in the general patient population will be reviewed, and differences found within the cardiac population will be described.

Socio-demographic Factors

Socio-demographic factors which may increase the risk of readmission of medical-surgical and HF patients include age, sex, marital status, living situation, and race.

Age. Patients greater than 60 years of age have been identified as at risk for readmission in multiple prediction model studies utilizing general medical-surgical populations (Escobar et al., 2015; French et al., 2008; Jennings, Petricca, Yageman, ODell, & Kalus, 2006; Silverstein, Qin, Mercer, Fong, & Haydar, 2008). The amount of teaching content received during the inpatient stay may be a factor in readmission outcomes of the older adult. Medical-Surgical patients in the advanced age group (greater than 85) have reported they do not receive as much discharge information as younger groups (Bobay, Jerofke, Weiss, & Yakusheva, 2010).

Age differences are not a consistent predictor in HF readmission studies. There has been an increased rate of hospitalization of HF patients under the age of 65 (Hall, Levant, & DeFrances, 2012) and evidence suggests young and middle aged HF patients

have readmission rates similar to elderly patients (Ranasinghe et al., 2014). For example, in a comparison of 4,548 HF patients aged 18-64 years, there were no age differences observed between readmitted and non-readmitted groups (Allen, Smoyer Tomic, Smith, Wilson, & Agodoa, 2012). Younger patients were at greater risk for readmission if they had co-morbidities and prior healthcare utilization. Since there are growing numbers of HF patients under the age of 65, it is important to understand how age affects discharge teaching and readmission outcomes.

Sex. Most retrospective studies utilizing large databases have identified male sex as a predictor of increased hospital readmission in medical-surgical patient populations (Escobar et al., 2015; French et al., 2008; Jennings et al., 2006; Kind, Smith, Frytak, & Finch, 2007; Silverstein et al., 2008; van Walraven, Wong, & Forster, 2012). A recent exception was a study of hospital readmission data over a two year period from 16 states (Henke.R.M. et al., 2015). In this study, women were readmitted to the same hospital more often than men for all included conditions except myocardial infarction (MI). An explanation to this finding was not offered but the oldest age group was also a predictor of same hospital readmission in this study and women may have been more highly represented in this group.

Similar to studies of medical-surgical patients, male sex has been associated with an increased risk of HF readmission (Amarasingham et al., 2010; Gheorghiade et al., 2013). Yet evidence linking sex and HF readmission is mixed. In a pooled study population of 11,642 HF patients, Frazier et al. (2007) found that there were no gender differences in the number of hospital readmissions patients experienced.

Marital status and living situation. Social support variables such as marital status and living situation may contribute to hospital readmission. Studies describe patients who have experienced readmissions to be unmarried, widowed, and/or have an inadequate support system at home (Amarasingham et al., 2010; Chung et al., 2009; Roe-Prior, 2007). However, in a study using a large sample of 10,946 medical-surgical patients, married patients were more likely to be readmitted possibly due to the fact that a spouse allowed sicker patients the option of being discharged home (Hasan et al., 2010).

HF patients who are married or reside with family have been reported to have either a higher or equal incidence of readmission as compared to unmarried HF patients (Hammer & Ellison, 2005; Watkins, Mansi, Thompson, Mansi, & Parish, 2013). These mixed findings suggest other factors may be influencing the relationship between marital status and readmissions. Wu, et al. (2011) found medication adherence mediated the relationship between marital status and cardiac event free survival.

Race. Black patients are more likely to be readmitted within 30 days of hospital discharge (Escobar et al., 2015; Kind et al., 2008; Silverstein et al., 2008). Readmission and ED utilization risk is higher in black HF patients due to the influence of socioeconomic status and atherosclerotic risk factors (Chang et al., 2014; Hasegawa et al., 2014; Roger, 2013). Black patients with HF have 13% higher odds of readmission than white HF patients, and risk increases if care is received at a facility which predominately serves minority populations (Joynt, Orav, & Jha, 2011; Vivo et al., 2014). Racial disparities in access to care may explain differences in HF readmission rates between black and white patients. In a study of Veterans Administration patients, equal

access to HF care reduced the healthcare utilization gap between black and white patients (Deswal, Petersen, Souchek, Ashton, & Wray, 2004).

Barriers to Learning

Barriers to learning which may influence the amount of discharge teaching provided to medical-surgical and HF patients include health literacy and constant or non-modifiable factors which could affect learning.

Poor Health Literacy. Health literacy has been defined as *"the ability to read and understand prescription medication instructions, appointment cards, and health materials and to process and understand basic health information and services in order to function successfully in the patient role and to make effective health decisions"* (Riegel et al., 2009, p. 1150). Health literacy is a mediator of information exchange between the patient and the provider (Edwards, Davies, & Edwards, 2009). Patients who successfully self-manage their chronic disease exhibit the skills to know when and where to seek health information. They adequately describe their health issues and understand the response of the provider, comprehend written instruction provided, have the capacity to process and retain information, and have the ability to decide if they will act upon the information (Jordan, Buchbinder, & Osborne, 2010).

The prevalence of inadequate and marginal health literacy skills has been reported to range between 36 – 61% and is negatively associated with disease knowledge and confidence in self-care behaviors (Dennison et al., 2011; Federman, Sano, Wolf, Siu, & Halm, 2009; Gazmararian, Williams, Peel, & Baker, 2003). Studies have demonstrated

HF patients with lower levels of health literacy are at greater risk of medication non-adherence (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011; Wiggins, Rodgers, DiDomenico, Cook, & Page, 2013), and may require increased exposure to medication teaching during the inpatient stay to lessen the risk of hospital readmission (Berkman et al., 2011).

Language proficiency and its subsequent effect on health literacy may explain ethnic disparities in HF readmission rates. HF patients who are foreign born and/or do not speak English as their primary language are 1.58 times more likely to be readmitted than English speaking patients (Peterson et al., 2012). Regalbuto et al. (2014) found patients who did not speak English had significantly less understanding of their discharge instructions than English speaking patients and were 2.2-fold more likely to be readmitted.

Non-modifiable Barriers to Learning. Additional barriers to learning which are non-modifiable include factors such as hearing loss, language, and vision impairments (Burkhart, 2008). In addition, specific cognitive impairments which could impact learning in persons with HF are attention and memory deficits (Dickson, Tkacs, & Riegel, 2007). Cognitive ability may in part explain the association between health literacy and retention of information. Prevalence of moderate to severe cognitive impairment in the hospitalized HF patient population has been reported to be as high as 21.6% (Dodson, Truong, Towle, Kerins, & Chaudhry, 2013). In a study of community-dwelling older adults, elders with abnormal delayed and immediate recall, decreased verbal skills, and Mini-Mental State Evaluation (MMSE) scores had a 3-5 times greater odds of inadequate health literacy (Federman et al., 2009).

Clinical Condition Factors

Clinical condition factors which are identified during the hospital stay persist at time of hospital discharge, and increase the risk of hospital readmission include functional status, severity of illness, medication non-adherence and resource utilization.

Functional status. Patients may leave the hospital with new or pre-existing self-care deficits such as the inability to independently complete bathing, dressing, eating, getting out of bed or ambulating. These functional disabilities have been demonstrated to increase the risk of readmission, and if the deficit is newly identified during hospitalization there is even greater risk to the patient (DePalma et al., 2013).

Although most patients who are admitted for HF experience significant improvement during the hospital stay, the odds of readmission increase when symptoms of persistent HF are still present at time of discharge (DeVore et al., 2014). Hospital readmission is often precipitated by subclinical congestion rather than a low cardiac output (Gheorghiade et al., 2013). Symptoms may be aggravated by the occurrence of a recent hospitalization. If the patient has been placed on bed rest during the hospital stay, they are more likely to experience functional decline (Brown, Friedkin, & Inouye, 2004). This inactivity may continue after discharge, leading to a future hospital readmission (Borenstein et al., 2013; Fisher et al., 2013; Wong & Miller, 2008). Heart failure patients requiring assistance with activities of daily living at the time of hospital discharge are 10.3 times more likely to be readmitted and patients with pulmonary rales at the time of discharge are 5.41 times more likely to be readmitted within 60 days (Anderson, 2013).

Severity of illness. Patients experiencing healthcare utilization within 30 days of hospital discharge present with complex clinical conditions. Patients who are readmitted are more likely to have five or more co-morbidities (Friedman et al., 2008). Co-morbidities such as respiratory disorders (Foraker et al., 2011; Jennings et al., 2006; Lum, Studenski, Degenholtz, & Hardy, 2012; Madigan, 2008), poor renal function (Fonarow et al., 2008; Sherer, Crane, Abel, & Efird, 2014; VanSuch et al., 2006), depression (Amarasingham et al., 2010; Rathore, Wang, Druss, Masoudi, & Krumholz, 2008; Sayers et al., 2007), or acute cardiac disorders such as arrhythmia, chest pain, or myocardial infarction (Fonarow et al., 2008; Gharacholou et al., 2011; Lum et al., 2012; Sherer et al., 2014; Zai et al., 2013), have been associated with a higher risk for re-hospitalization. Allen et al. (2012) found patients readmitted to the hospital were more likely to have had dialysis, a cardiac procedure, an ICU stay, and a longer length of stay during their index hospitalization.

HF patients also tend to have multiple co-morbidities complicating their illness. Patients with three to four co-morbidities have been demonstrated to have a 3.6-fold increased risk of hospital readmission (Sherer et al., 2014). Adherence to HF treatment post-discharge can be complicated by the presence of psychological co-morbidities of chronic illness. Hospitalized HF patients with co-morbid depression may experience longer lengths of stay, increased hospital costs, and a higher incidence of hospital readmission (Penninx et al., 2001; Rathore et al., 2008; Sayers et al., 2007). Depression has been identified as a risk factor for non-adherence with medical treatment, amplification of symptoms, functional impairment, and mortality (DiMatteo, Lepper, & Croghan, 2000; Imazio et al., 2008; Katon & Ciechanowski, 2002).

The Elixhauser co-morbidity score was developed to measure severity of illness based on 30 co-morbid conditions unrelated to the primary reason for hospitalization. In comparison to a similar rating tool, the Charlson score, the Elixhauser co-morbidity score has the advantage of the addition of potentially acute illnesses such as coagulopathy, weight loss and fluid and electrolyte imbalance, while eliminating illnesses unrelated to outcomes and conceptually inappropriate diagnoses such as benign prostatic hypertrophy and diverticulosis (Elixhauser, Steiner, Harris, & Coffey, 1998). Press et al. (2013) successfully utilized the Elixhauser co-morbidity score as well as age, sex, principal diagnosis, and prior hospitalization to model a severity risk measure to compare all cause readmission rates within 30 days of discharge among patients admitted with HF. Patients in higher severity quartiles had higher readmission rates than patients in the lower severity quartiles over all three years of data included in the study.

Medication non-adherence. Medical management of multiple co-morbidities often requires extensive medication regimes. Patients taking four or more drugs daily are at an increased risk for Emergency Department utilization (Weiss, Costa, Yakusheva, & Bobay, 2014). The risk for readmission to the hospital increases when HF patients are prescribed more than nine medications (Sherer et al., 2014). Medication non-adherence and adverse drug events are contributing factors in post-discharge mortality and hospital readmission (Fitzgerald et al., 2011; Fonarow et al., 2008; Guharoy et al., 2007; Ho et al., 2009; Wu, 2012).

Medication reconciliation is completed as a standard discharge process to ensure patients are taking the appropriate medications post-discharge. Studies demonstrating increased medication adherence by the patient or decreased readmissions have included

inpatient interventions such as medication teaching by pharmacists (Gilmore et al., 2015; Warden, Freels, Furuno, & Mackay, 2014) or motivational interviewing by clinical nurses after intensive training on the technique (Hyrkas & Wiggins, 2014).

Medication self-management is critical in the treatment of HF for two reasons: (a) medications reduce mortality and (b) medications improve functional capacity through the management of symptoms (Agency for Health Care Policy and Research, 1994). Medication instruction has been identified as an essential educational component during the inpatient stay (Adams et al., 2006). Assessment of medication adherence is recommended at admission and, once non-adherence is identified, strategies to overcome these barriers should be incorporated into the education plan (Ho et al., 2009).

Resource Utilization. A previous hospitalization within the year prior to admission or Emergency Department (ED) utilization within six months prior to admission have been positively associated with hospital readmission (Borenstein et al., 2013; Gruneir et al., 2011; Hummel, Katrapati, Gillespie, DeFranco, & Koelling, 2014; Jencks et al., 2009; van Walraven et al., 2012). Risk rises when the index hospitalization length of stay increases (Au et al., 2012; Escobar et al., 2015; Jencks et al., 2009; Shu, Lin, Hsu, & Ko, 2012). Each day of inpatient length of stay is associated with a 1% increase in readmission (French et al., 2008). The patient may remain hospitalized due to modifiable factors such as their clinical condition or lack of support at home. As discussed earlier in this chapter, a prolonged hospital stay may result in decreased functional capacity which could continue after discharge, leading to future readmissions (Borenstein et al., 2013; Fisher et al., 2013; Wong & Miller, 2008).

Exposure to HF Discharge Teaching – Gaps in the Literature

Little is known about the efficacy of HF discharge teaching. It is generally accepted that discharge teaching should be frequently delivered throughout the hospital stay, but there is a paucity of evidence supporting the efficacy of brief teaching interventions (Coster & Norman, 2009). Few studies have specifically examined the relationship of HF discharge teaching or frequency of HF discharge teaching to hospital readmission (Nielsen et al., 2008).

One study defined teaching intensity as medical intern and resident to hospital bed ratio. The relationship between low teaching intensity, medium teaching intensity, and high teaching intensity hospitals to the composite score of hospital-level performance on The Joint Commission quality of care core measures for HF and readmission rates was explored (Mueller et al., 2013). Hospitals with higher levels of teaching intensity had higher rates of HF readmission. Possible explanations offered for the increased readmission finding were the lack of risk adjustment for patient characteristics and high acuity of the patients served in the high teaching intensity hospitals. A limitation of this study was a lack of documentation data to validate the HF instruction was provided by a medical resident, a nurse, or both and the use of hospital level administrative data to calculate the medical intern / resident to bed ratio.

Bundling of the HF core measures into one composite score assumes a direct relationship between each core measure. A rigorously controlled study conducted by the Health Services Advisory Group of the Centers for Medicare and Medicaid examined the direct relationship between all of the individual Joint Commission HF core measures and

hospital readmission (CMS, 2015). Completion of the HF-1 patient education core measure was associated with a slightly higher risk for readmission. The HF core measure with the greatest effect on the reduction of all cause readmission within one year was HF-3, which measured the provision of an ACE inhibitor for left ventricular systolic dysfunction. Since CMS data was utilized for this study, there was a lack of inclusion of patients less than age 65 in the sample.

Jensen (2011) conducted a study to determine the relationship of completion of HF-1 core measure to hospital readmission. The study also examined the relationship of nursing unit factors to completion of the HF-1 core measure. The association between performance on the core measure and hospital readmission was non-significant at the 30 day post-discharge measurement. However, there was a strong positive association between the type of discharge unit and completion of the discharge instruction core measure, with patients discharged from cardiac specialty units experiencing better readmission outcomes.

VanSuch et al. (2006) conducted a retrospective chart review of 1121 randomly selected HF discharges to examine the relationship of documentation compliance to any or all of the six components of required HF-1 core measures and the outcomes of hospital readmission and mortality. Of the 1121 charts selected, 782 met the inclusion criteria of greater than 18 years of age and discharge to home with or without home care. Sixty-eight percent (532 of 782) of the patients received all six components of the required instruction. Of the 250 patients with missing documentation, 15 were missing all six of the components. The most frequent grouping not documented was activity, weight, and symptom monitoring. Patients who received all six components of instruction were

significantly less likely to be readmitted for heart failure (p = .03) than patients who had missing documentation of at least one component. Patients who had received all of the components had a significantly longer time to all cause readmission, but the relationship was non-significant for HF readmissions after controlling for co-variates such as renal disease, geographic distance from the hospital, and all patient refined diagnostic related groups weight. No relationship was found between documentation of the discharge teaching components and patient mortality after discharge over the 12 month data collection period. Limitations of the study were the lack of controls related to unit level effects, the possibility that teaching was provided and not documented, and lack of follow-up post-discharge which might have resulted in an under-reported death rate.

White, Garbez, Carrol, Brinker, & Howie-Esquivel (2013) demonstrated that 60 minutes of HF education from a HF nurse expert utilizing the teach-back method was associated with improved retention of information in HF patients. However, correctly answering the teach-back questions was not associated with a decrease in hospital readmission. In contrast, in a randomized controlled trail of 223 hospitalized HF patients, patients receiving a one hour long education session with a nurse educator had fewer rehospitalizations than patients exposed to standard care (Koelling et al., 2005).

A pilot study measuring the effectiveness of the implementation of a HF education clinical pathway to provide education to 59 HF patients on medical-surgical units over a period of two months demonstrated promising results (White, S., 2014). The four day educational pathway was developed, with the input of clinical nurses, to coincide with the average length of stay of the HF patient. Education was provided over the course of the hospital stay and a phone call was made to the patient 48 hours post-

discharge. Performance on readmission outcomes were compared pre and post implementation and the rate of readmission decreased from 23.1% to 12.9%. Limitations of this pilot were the lack of patient controls or the use of a control group in the design.

Previous studies have failed to demonstrate a relationship between the completion of The Joint Commission core measures and HF readmission after controlling for co-variates (CMS, 2015; Jensen, 2011; VanSuch et al., 2006). The provision of one hour of HF education by a nurse expert has been linked to an increase in retention of information, but findings with regard to a decrease in hospital readmission have been mixed (Koelling et al., 2005; White, S.M. et al., 2013). The link between HF teaching and hospital readmission might be better understood if nursing documentation was examined to determine which HF teaching components matter and what teaching frequency produces the best outcome.

Teaching may be provided one time on day of discharge, or provided by several nurses over the course of the index admission based on patient need. There is a scarcity of evidence linking HF discharge teaching by a nurse to avoidance of HF readmission. Studies examining HF discharge teaching have been focused on the completion of educational components which were required for quality reporting. Further research is warranted to establish which HF educational components are critical to the avoidance of readmission and to identify the frequency of teaching exposure necessary to reduce HF readmission in the 30-day post-discharge period.

Research Questions

The purposes of this study are to: (a) describe the association between the dose of discharge teaching provided to HF patients during the hospital stay and the outcome of hospital readmission within 30 days, after controlling for clinical condition, patient characteristics, unit type and hospital effects, inpatient teaching by a pharmacist and transitional care; (b) examine whether clinical condition, and patient characteristics moderate the relationship between HF discharge teaching dose and HF readmission within 30 days of discharge; (c) explore the relationship between the number of HF teaching components received and hospital readmission within 30 days, and (d) identify which HF teaching components of an evidenced-based HF teaching plan embedded in the electronic health record (EHR) were associated with a decreased probability of hospital readmission. These aims will be addressed through answering the following research questions:

Research Question 1: What is the association between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days, after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

Research Questions 2: Do patient characteristics and clinical condition factors moderate the relationship between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

Research Question 3: What is the relationship between the dose of the seven hospital-required HF discharge teaching components included in the HF teaching plan and hospital readmission or ED utilization of HF patients within 30 days of discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

Research Question 4: How many HF teaching components are needed to reduce the risk of HF readmission or ED utilization within 30 days of hospital discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists, and transitional care?

Research Question 5: Which components of the HF teaching plan, when provided together, are associated with a decreased probability of HF readmission or ED utilization after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

Philosophical Underpinnings: Post-Positivism

Scientific inquiry is guided by paradigms which provide a context or lens for understanding, manipulating, and applying knowledge (Guba, 1990). A paradigm is a set of beliefs that influences the researcher's response to ontological, epistemological, and methodological questions when conducting disciplined inquiry (Guba, 1990; Howell, 2013). The philosophical paradigm of post-positivism underpins the methodological choices and assumptions in this study.

The goal of post-positivist research is parsimonious explanation and prediction (Guba, 1990; Howell, 2013). Inquiry is carried out in natural settings and may include

the processes of discovery and verification (Guba, 1990). The shift from context-free positivism to post-positivism began with Popper and Kuhn. Popper believed that theory development should be open to criticism (Howell, 2013). Kuhn argued that scientific theory evolves through a historical process rather than the accumulation of facts and is dependent on the emergence of new probabilities (Howell, 2013).

The ontology of post-positivism is critical realism. There is acknowledgment that reality cannot be fully comprehended (Guba, 1990). The epistemological assumptions of post-positivism are those of a modified objectivist: (1) objectivity can only be approximated and (2) reports should be consistent with scholarly tradition and open to critical external review by the scientific community (Guba, 1990). In the post-positivism paradigm, research methodology can be quantitative, qualitative, or mixed method depending on the research question and the desire to obtain differing perspectives (Guba, 1990; Houghton, Hunter, & Meskell, 2012). The utilization of post-positivism as a perspective from which to examine the process of discharge teaching allows for consideration of discrete variables which are quantifiable and may influence the outcome of interest. Retrospective analysis of the practice of discharge teaching will provide critical insight into the frequency of discharge teaching by nurses within the context of the hospital and unit, how discharge teaching dose is influenced by patient characteristics and clinical condition factors, and which components of HF discharge teaching are associated with avoidance of hospital readmission and ED utilization.

Statement of Assumptions

The following assumptions frame the view of the researcher when examining exposure of HF patients to discharge teaching delivered by nurses within the context of the acute care unit:

1. HF patients present to the hospital with exacerbation of their clinical condition.
2. HF patients admitted to the hospital in exacerbation have socio-demographic, clinical, and learning barriers unique to their situation.
3. Nurses participate in teaching activities within the context of a nursing unit, which may serve differing patient populations and are nested within hospitals that may differ in unmeasured resources and/or RN characteristics.
4. Nurses are the primary teacher, but other professions also teach.
5. Patients are the primary learner, but families may also be included in discharge teaching.
6. The provision of discharge teaching to patients and their families by nurses leads to learning and may contribute to the post-discharge course and the readmission outcomes.
7. For learning to occur, nurses must determine the patient's level of health literacy, constant barriers to learning, and discharge needs.
8. Nurses are equally effective in delivering the needed information in an organized and systemized way over the course of a hospital stay.
9. Nurses document the teaching components provided to the patient.
10. HF patients who have received exposure to the necessary components of HF information are more likely to take action to maintain their health condition.

11. HF patients who participate in the maintenance of their health condition are less likely to be readmitted to the hospital or experience an ED visit within 30 days of discharge.

Theoretical and Conceptual Framework

Effectiveness research provides a framework in which to examine specific nursing interventions associated with nursing processes and the extent to which these interventions contribute to the improvement of patient outcomes (Titler, Dochterman, & Reed, 2004). Interventions are tested under ordinary practice circumstances and with relatively few exclusions, more closely resembling the complexity found in clinical practice (Hastings-Tolsma, Matthews, Nelson, & Schmiege, 2013). The EHR provides an extensive data source for effectiveness research with the ability to control for co-variates within the dataset, allowing for increased understanding of the relationship of nursing interventions to outcomes of interest within complex systems.

The Model for Effectiveness Research (Titler et al., 2004; Titler et al., 2008; Titler, Shever, Kanak, Picone, & Qin, 2011) which informs this study consists of clinical condition factors, patient characteristic, treatment, and nursing unit or agency variables which may influence the patient outcome (Figure 2.1).

Figure 2.1 Model for Effectiveness Research

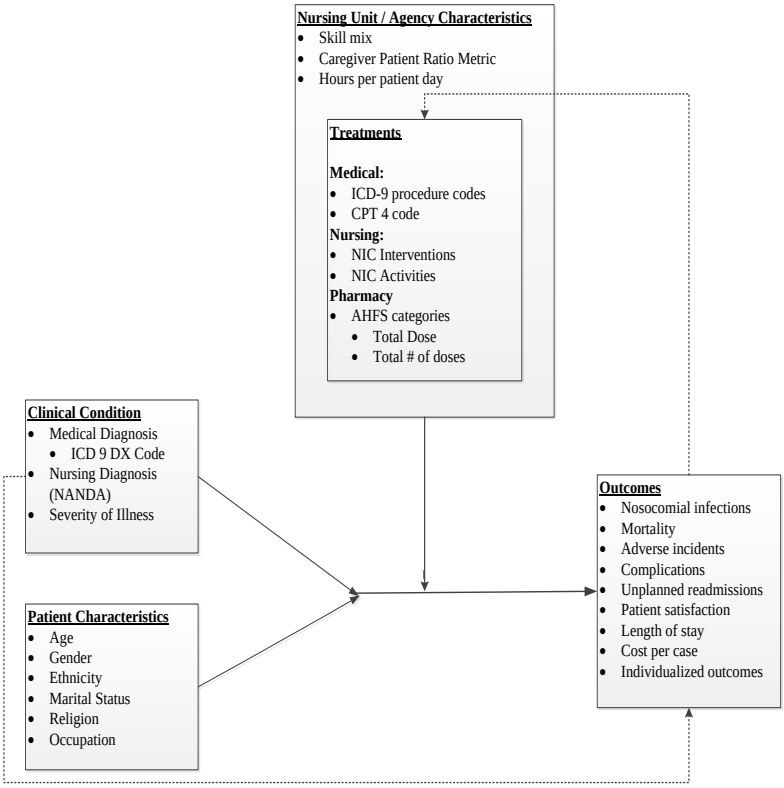


Figure 2.1. Model for Effectiveness Research. From: "Guideline for Conducting Effectiveness Research in Nursing & Other Healthcare Services", by M.B. Titler, J. Dochterman, & D. Reed. The University of Iowa College of Nursing Center for Nursing Classification & Clinical Effectiveness, Iowa City, IA.

The patient characteristic and clinical condition variables selected for this study were associated with HF readmission and extractable from the EHR. Figure 2.2 illustrates the study variable placement within the Model for Effectiveness Research. Nursing unit / agency characteristics controlled for variation in unit resources, RN characteristics, and patient population. The nursing intervention or treatment variable of interest were completion of the HF teaching components included in the hospital's fluid excess education plan. Discharge education provided by pharmacists during the hospital stay or by nurses during the post-discharge transition period were controlled for in the

analysis. The patient outcome variables were the occurrence of a HF hospital readmission or ED utilization to any of the system's hospitals within 30 days of a previous HF admission.

Figure 2.2. Model for Effectiveness Research : Relationship of Exposure to Heart Failure Discharge Teaching to Readmission within 30 Days

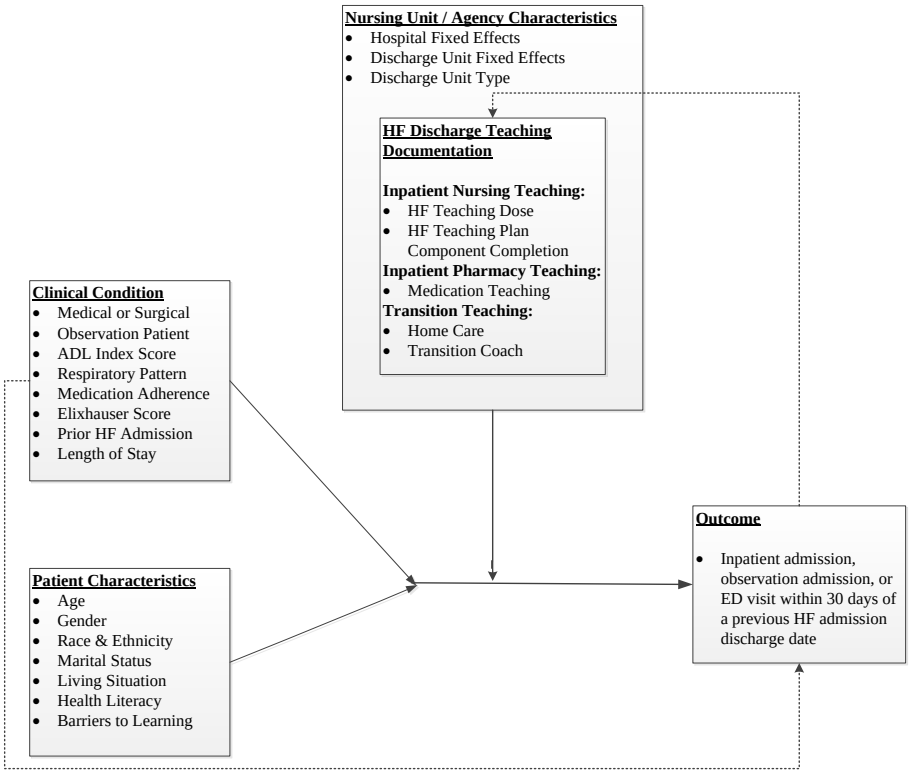


Figure 2.1. Model for Effectiveness Research: Relationship of Exposure to Heart Failure Discharge Teaching to Readmission within 30 Days. Adapted From "Guideline for Conducting Effectiveness Research in Nursing & Other Healthcare Services", by M.B. Titler, J. Dochterman, & D. Reed. The University of Iowa College of Nursing Center for Nursing Classification & Clinical Effectiveness, Iowa City, IA.

The conceptual-theoretical-empirical structure is displayed in Table 2.1.

Table 2.1 Conceptual-Theoretical-Empirical Structure

Model Concepts	Study Variables	Study Measures
Patient Level Characteristics and Clinical Condition Factors	(1) Patient Characteristics	(1) Age, sex, living situation, marital status, race and ethnicity, documented health literacy screening response, documented barriers to learning
	(2) Clinical Condition Factors	(2) Primary diagnosis of HF, patient type, observation status, independence with ADL index score, respiratory pattern, Elixhauser co-morbidity score, medication adherence, prior HF hospitalization, length of stay
Nursing Units / Agency Characteristics	(1) Organizational Effects	(1) Hospital, discharge unit, discharge unit population type
Treatments	(1) Inpatient Nursing Teaching	(1) HF teaching dose, HF teaching plan component completion
	(2) Inpatient Pharmacy Teaching	(2) Medication teaching
	(3) Transition Care	(3) Home care, transition coordinator
Outcome	(1) Hospital Readmission or ED utilization	(1) An inpatient admission, observation admission, or ED visit to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date

Summary

This chapter contained a review of the literature relevant to the clinical and socio-demographic patient characteristics and barriers to learning that place patients at risk for hospital readmission within 30 days of discharge. Factors which may influence the delivery of patient teaching during the inpatient stay were explored. Post-positivism provided the philosophical perspective which underpins the study assumptions regarding how nurses engage patients in patient education within the context of the inpatient nursing unit. Study variables and measurements and their relationship to the Model for Effectiveness Research demonstrate the conceptual-theoretical-empirical structure which guides this study.

CHAPTER 3

RESEARCH DESIGN AND METHODS

A detailed description and rationale for the research design and methods employed to achieve the purpose of this dissertation study are described in this chapter. The choice of design, setting and sample selection, variable definitions and measures, data pre-analysis and screening methods, statistical procedures, and protection of human subject information are provided.

Research Design

A retrospective observational correlational design was utilized to test the association between the outcome variables of HF patient readmission and ED utilization within 30 days of discharge and exposure to discharge teaching after controlling for clinical condition, patient characteristics, hospital and unit type effects, inpatient teaching by pharmacists and transitional care. This retrospective design was chosen as an appropriate method of evaluating how the predictor variables which had been documented in the electronic health record (EHR) may be linked to an outcome that had already occurred in the pre-existing group of HF patients (Hulley, Cummings, Browner, D.G., & Newman, 2007).

Research Questions

The aims of this study were to (a) describe the association between the aggregate component dose of teaching (defined as the frequency of teaching occurrences for all HF

teaching components of the fluid volume excess teaching plan) documented during the length of the first or index hospitalization within the study data range and the outcome of hospital readmission or Emergency Department (ED) utilization within 30 days after controlling for clinical condition, patient characteristics, unit type and hospital effects, inpatient teaching provided by a pharmacist and transitional care; (b) examine whether clinical condition factors and patient characteristics moderate the relationship between the aggregate component dose and HF readmission or ED utilization within 30 days of discharge; (c) explore the relationship between the dose of each of the HF discharge teaching components documented and hospital readmission or ED utilization within 30 days, (d) determine if there was an association between the number of components provided and post-discharge outcomes, and (e) identify which HF teaching components of an evidenced-based HF teaching plan embedded in the electronic health record (EHR) were associated with a decreased probability of hospital readmission or ED utilization. These aims were addressed by answering the following research questions (RQ):

RQ1: What is the association between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days, after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

RQ2: Do patient characteristics and clinical condition factors moderate the relationship between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days after controlling for

clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists, and transitional care?

RQ3: What is the relationship between the dose of the seven hospital-required HF discharge teaching components included in the HF teaching plan and hospital readmission or ED utilization of HF patients within 30 days of discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

RQ4: How many HF teaching components are needed to reduce the risk of HF readmission or ED utilization within 30 days of hospital discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists, and transitional care?

RQ5: Which components of the HF teaching plan, when provided together, are associated with a decreased probability of HF readmission or ED utilization after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

Research Methods

Setting and Data Source

Consecutive retrospective sampling was performed over an 18 month period to include eligible HF patients discharged from Medical, Medical-Surgical, Surgical, Neuro,

and Cardiac units within 4 hospitals (referred to as hospitals A-D) associated with a 14 hospital Midwestern health care system. The hospitals assessed discharged an average of 6,493 HF patients from 2014 to 2015. HF discharges from the 4 hospitals ranged from 8 to 31% of their total discharges. Each site had a different bed capacity therefore; variation in the total number of HF patients by site was expected. Table 3.1 describes the diversity of the patient population of the study sites.

Table 3.1 Ethnic Profile of Population Served by Hospital with United States (US) Comparison

Hospital	White/ Non-Hispanic	Hispanic	Black	Asian/ Pacific	Native American	Hawaiian/ Pacific Is	Refused/ Unknown
US	63.7%	12.3%	12.6%	4.8%	0.9%	0.2%	6.2%
A	89.0%	3.3%	1.4%	2.7%	1.3%	0.1%	2.3%
B	20.4%	7.1%	62.9%	4.1%	0.4%	0.1%	5.1%
C	73.6%	9.0%	13.6%	1.3%	0.5%	0.1%	2.0%
D	77.8%	6.1%	8.2%	2.8%	0.5%	0.1%	4.6%
4 Hospital Total	65.8%	7.8%	20.3%	2.2%	0.5%	0.1%	3.3%

Adapted From Humes, Jones, & Ramirez (2011). Overview of race and Hispanic origin: 2010. US Census Bureau. C2010BR-02.

The four hospitals included in this study utilized a single shared EHR database product developed by Epic Systems Corporation©. The inpatient clinical documentation product within the Epic system had been standardized for use by nurses and disseminated across the healthcare system. When the HF core measures were being publicly reported (July 2002 – January 2014), a core measures report provided patient level data on the number of core measures completed.

Patients were included in the study if they were discharged from one of the study sites from January 1, 2014 through June 30, 2015. This time frame occurred immediately

after the HF-1 core measure became a voluntary measure (January, 2014). The hospital HF core measure report was discontinued in 2015. However, the healthcare system did not change their HF teaching plan because the educational components remained consistent with HF guidelines. Additionally, the HF teaching plan was consistent with current CMS value based purchasing process and outcome requirements for appropriate discharge instruction, medication teaching, and prevention of HF readmission. Nurses continued to be instructed to complete the HF-1 core measures embedded within the 15 component HF education plan and they could monitor their practice by viewing a tab within the EHR which identified which components had been completed.

The index hospitalization was defined as the first inpatient or observation hospitalization, with a primary diagnosis of HF, within the study data range. Billing data was utilized to identify the HF patients and their comorbid conditions. Clinical condition data, patient characteristic data, and the documented occurrence of heart failure discharge teaching were electronically extracted from the EHR for all eligible patients.

Selection of Sample Participants

Patients selected for the study had a primary diagnosis of HF and were identified by the International Classification of Diseases (ICD-9) Medical Procedure Code 428.0 through 428.9 (see Table 3.2 for inclusion codes). HF patient encounters were included in the study if they were discharged to home with or without home care after hospitalization. Each unique patient was included once in the sample. The patient's readmission hospitalization and all the patient's subsequent readmission episodes during the data range were excluded.

Table 3.2: Primary Diagnosis and ICD-9 Code for Included Participants

Diagnosis	ICD-9 Code
Congestive Heart Failure, Unspecified	428.0
Left Heart Failure	428.1
Systolic Heart Failure, Unspecified	428.20
Systolic Heart Failure, Acute	428.21
Systolic Heart Failure, Chronic	428.22
Systolic Heart Failure, Acute on Chronic	428.23
Diastolic Heart Failure, Unspecified	428.30
Diastolic Heart Failure, Acute	428.31
Diastolic Heart Failure, Chronic	428.32
Diastolic Heart Failure, Acute on Chronic	428.33
Combined Systolic and Diastolic Heart Failure, Unspecified	428.40
Combined Systolic and Diastolic Heart Failure, Acute	428.41
Combined Systolic and Diastolic Heart Failure, Chronic	428.42
Combined Systolic and Diastolic Heart Failure, Acute on Chronic	428.43
Heart Failure, Unspecified	428.9

Patients were excluded from the study if they died during the index hospitalization or were transferred to another acute care setting, inpatient rehabilitation, or skilled nursing facility. Discharged patients who were at high risk for readmission due to terminal illness were also excluded from the study. This included patients discharged to home hospice, or inpatient hospice. Patients with conditions that may have influenced the relationship between discharge teaching, the retention of health information, and hospital readmission were also excluded (Federman et al., 2009). These included patients with a history of Alzheimer's or dementia (see Table 3.3 for exclusion codes).

Table 3.3: Diagnosis and ICD-9 Code for Excluded Participants

Diagnosis	ICD-9 Code
Senile Dementia, Uncomplicated	290.0
Pre-Senile Dementia,	290.1
Senile Dementia with Delusional or Depressive Features	290.2
Senile Dementia with Delirium	290.3
Vascular Dementia	290.4
Other Specified Senile Psychotic Condition	290.8
Unspecified Senile Psychotic Condition	290.9
Alzheimer's Disease	331

Determination of Sample Size

Since the outcome variable for all the models were binary, the analysis method selected to answer these research questions was logistic regression. The sample size was determined using G*Power 3.1.9 (Faul, Erdfelder, Buchner, & Lang, 2009). A sample size of 770 unique HF patients was projected to provide 80% power at the 0.05 level of significance, with a correction of 0.15 for the influence of other covariates, and an odds ratio of 1.3 (medium effect size) in estimating the influence of the independent variable on the dependent variable of hospital readmission. To ensure adequate power, the minimum sample size was adjusted to 1090 by adding 10 cases for each additional variable included in the analysis (Warner, 2013). A post hoc computation of power demonstrated a sample size of 1383 observations achieved 97% power at the .05 level of

significance and an odds ratio of 1.5; indicating the actual sample size of 1383 was sufficient to perform the analysis.

Study Variables

The patient characteristic and clinical condition factors selected for this study were control variables associated with HF readmission. They were abstracted at the patient level from the EHR. There were 4 hospitals and 5 discharge unit types entered as 3(n-1) and 4(n-1) unit effects to account for organizational variation which may have impacted the outcome but were not measured. The intervention or treatment variable of interest was exposure to the HF teaching components included in the hospital's HF fluid volume excess education plan. To adjust for the fact that patients had differing teaching exposure due to variation in the number of days hospitalized, length of stay was controlled for in the analysis. The patient outcome or dependent variable was the occurrence of an inpatient or observation admission or an ED visit to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date.

Treatment or Independent Predictor Variables

The fluid volume excess teaching plan was the HF education plan embedded in the electronic health record (EHR). The treatment or independent predictor variables in this study were the documented occurrences of the teaching components within the HF fluid volume excess teaching plan. The plan consisted of fifteen HF teaching components standardized based on national guidelines. These included: causes of fluid volume excess, fluid volume excess treatment plan, symptom monitoring, sodium

restriction, fluid restriction, overcoming barriers to adherence to the treatment plan, diuretic titration, outpatient resources, HF specific causes, weight monitoring, activity level, diet and fluid intake, medications, follow-up, and symptoms worsening.

The aggregate component dose was operationalized as the frequency of documented teaching occurrences for all HF teaching components of the fluid volume excess teaching plan aggregated over the entire index hospitalization. Teaching component dose was the frequency of documented teaching occurrences for each HF teaching component of the fluid volume excess teaching plan aggregated over the entire index hospitalization. Teaching component count was the number of components of the fluid volume excess teaching plan documented during the index hospitalization. Since the study purpose was to describe the effect of discharge teaching provided by inpatient nurses, exposure to pharmacy teaching prior to discharge or transitional care (teaching by a home care nurse or transition coordinator during the 30 day post-discharge transition period) was controlled for in the analysis. A detailed list of variables is presented in Table 3.4.

Outcome Variables

The dependent variables of hospital readmission or ED utilization within 30 days of discharge were the outcomes of interest for all research questions. Hospital readmission was defined as an inpatient or observation admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date. ED utilization was defined as an ED visit to any of the system's hospitals for HF within 30

days of a previous HF hospitalization discharge date without a concurrent admission. The statistical model utilized to answer the research questions was:

$$L_i = exp\ (B_0 + B_1X_1 + \cdots + B_kX_k)$$

On the left side of the equation L_i is the odd function $\frac{p}{1-p}$, where p is the probability of readmission. On the right side of the formula, *exp* is the exponential function and B_0 is the intercept. B_1 represents the regression coefficient multiplied by the value of each X predictor shown in Tables 3.4. The coefficients associated with the variables indicate the strength of the relationship of each predictor variable and the outcome of HF readmission (Warner, 2013).

Control Variables

HF patient characteristics which increase the risk of hospital readmission were utilized as control variables. These included clinical condition, socio-demographic and learning assessment variables described and defined in Table 3.5. The two learning assessment variables included in the study proposal were barriers to learning and health literacy. The barrier to learning variable was eliminated due to an unacceptable amount of missing data. The second variable, health literacy, was measured by a one item health literacy screening question in the nursing admission assessment. *"How confident are you in filling out medical forms?"* This brief screening question was developed by Chew, Bradley, and Boyko (2004). In their findings, an answer of "somewhat" confident identified 80% of patients with inadequate health literacy. All control variables in the

conceptual framework are summarized and defined in Table 3.5, including the variables which were eliminated during the data screening process.

Table 3.4: Relationship of Research Question, Predictor & Outcome Variable Measurement

Research Question	Variable Name & Definition	Level & Type of Measurement
What is the association between the dose of HF discharge teaching documented in the hospital and HF readmission or ED utilization within 30 days, after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?	**Aggregate component dose:** The frequency of documented teaching occurrences for all HF teaching components of the fluid volume excess teaching plan aggregated over the entire index hospitalization	Continuous Predictor
	HF readmission within 30 days of prior discharge: An inpatient or observation admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date	Dichotomous: 0 = No 1 = Yes Outcome
	ED utilization within 30 days of prior discharge: An ED visit without concurrent admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date	Dichotomous: 0 = No 1 = Yes Outcome
Do patient characteristics and clinical condition factors moderate the relationship between the dose of HF discharge teaching provided in the hospital and HF readmission or ED utilization within 30 days and after controlling for hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?	**Aggregate component dose:** The frequency of documented teaching occurrences for all HF teaching components of the fluid volume excess teaching plan aggregated over the entire index hospitalization	Continuous Predictor
	Patient characteristics & clinical condition factors: Sociodemographic characteristics and clinical condition factors defined in Table 3.5	Continuous, Dichotomous & Categorical Moderator Dichotomous:

	HF readmission within 30 days of prior discharge: An inpatient or observation admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date **ED utilization within 30 days of prior discharge:** An ED visit without concurrent admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date	0 = No 1 = Yes Outcome Dichotomous: 0 = No 1 = Yes Outcome
What is the relationship between the dose of the seven hospital-required HF discharge teaching components received and hospital readmission or ED utilization of HF patients within 30 days of discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by a pharmacist and transitional care?	**Discharge teaching component dose:** The frequency of documented teaching occurrences for each of the seven hospital- required HF discharge teaching components of the fluid volume excess teaching plan aggregated over the entire index hospitalization **HF readmission within 30 days of prior discharge:** An inpatient or observation admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date. **ED utilization within 30 days of prior discharge:** An ED visit without concurrent admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date.	Continuous Predictor Dichotomous 0 = No 1 = Yes Outcome Dichotomous: 0 = No 1 = Yes Outcome
How many of the fifteen HF discharge teaching components included in the HF teaching plan are needed to reduce the risk of HF readmission or ED utilization within 30 days of hospital discharge after controlling for clinical condition factors, patient characteristics, hospital and	**Teaching component count:** The number of components of the fluid volume excess teaching plan documented during the index hospitalization **HF readmission within 30 days of prior discharge:** An inpatient or observation admission to any of the system's hospitals for HF within 30	Continuous 0-15 Predictor Dichotomous 0 = No 1 = Yes Outcome

unit type effects, inpatient teaching provided by pharmacists and transitional care?	days of a previous HF hospitalization discharge date. **ED utilization within 30 days of prior discharge:** An ED visit without concurrent admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date.	Dichotomous 0 = No 1 = Yes Outcome
Which of the 15 components of the HF teaching plan, when provided together, are associated with a decreased probability of HF readmission or ED utilization after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?	**Teaching component dose:** The frequency of documented teaching occurrences for each teaching component aggregated over the length of the index hospitalization **HF readmission within 30 days of prior discharge:** An inpatient or observation admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date. **ED utilization within 30 days of prior discharge:** An ED visit without concurrent admission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date.	Dichotomous 0 = No 1 = Yes Predictor Dichotomous 0 = No 1 = Yes Outcome Dichotomous: 0 = No 1 = Yes Outcome

Hospital and Unit Level Effects

Hospitals in the study sample utilized the same HF teaching plan. Within these hospitals, patients were placed on units. To adjust for the fact those patients may have experienced unobserved variation in care; hospital and unit type were included as unit level effects at the patient level. Including the hospital and unit type effect controlled for the variables that were not measured such as staffing, skill mix, and patient population.

A nested design allowed for associations between unobserved (within-hospital and within-unit) variables and the observed variables selected for the study (Howell, 2010).

Table 3.5: Control and Fixed Variables and Level of Measurement

Variable Category	Variable Name	Definition	Level of Measurement	Type of Variable
Patient Characteristics	Age	Age of the patient in years at the time of hospitalization.	Continuous Minimum = 18 Maximum = 90 or >	Control
	Sex	Biological identification as a member of either the male or female sex.	Dichotomous 0 = Female 1 = Male	Control
	Marital Status	The state of being married, separated / divorced, or single / widowed.	Categorical 0 = Married 1 = Single 2 = Divorced 3 = Unknown	Control
	Race	Identifies with a racial population	Categorical 0 = White 1 = Black 2 = Asian 3 = Other	Control
	Hispanic Ethnicity	Identifies with Hispanic cultural group	Dichotomous 0 = No 1 = Yes	Control
	Lives Alone	The support in place within the home setting after day of discharge	Categorical 0 = Does not live alone 1 = Lives alone 2 = Unknown	Control
	Health Literacy	Answer to health literacy screening tool: How confident are you in filling out medical forms?	Categorical 0 = Not able 1 = Somewhat/ A little bit 2 = Extreme/ Quite a bit 3 = Not recorded	Control

Variable Category	Variable Name	Definition	Level of Measurement	Type of Variable
	Barriers to Learning Admission Screen	Reading Language Visual Hearing Cognitive Financial Spiritual Cultural	Dichotomous 0 = No 1 = Yes	Deleted
Clinical Condition Factors	Patient Type	Classification as a Medical or Surgical Patient	Dichotomous 1 = Medical 2 = Surgical	Deleted
	Observation Patient	A hospital stay lasting less than 48 hours with specific goals and plan of care	Dichotomous 0 = No 1 = Yes	Control
	ADL Index Score	Last recorded measure of the level of ADL assistance needed utilizing a modified Katz Index of Independence in Activities of Daily Living Index ranging from 0 – 12 with 0 being dependent and 12 being independent	12 = Independent 10-11 = Partially independent 7-9 = Somewhat dependent 1-6 = Highly dependent 0 = Missing or outside possible range	Control
	Respiratory Pattern	Last recorded subjective respiratory pattern assessment.	Categorical 0 = Denies shortness of breath 1 = Verbalizes shortness of breath (SOB) with rest 2 = Verbalizes SOB with activity 3 = Not recorded	Control

Variable Category	Variable Name	Definition	Level of Measurement	Type of Variable
	Prior HF Admission	Prior hospitalization for HF	Dichotomous 0 = No 1 = Yes	Control
	LOS	Calculated from the day of hospital admission to day of discharge and based on the number of nights the patient was hospitalized.	Continuous	Control
	Elixhauser Co-morbidity Score	Uses 30 co-morbidity groups to summarize a measure of disease burden. Calculated by assigning a point value for each diagnostic group and summing the score	Continuous	Control
	Medication Non-Adherence	Assessment of medication adherence conducted at time of hospital admission.	Categorical 0 = Taking meds as prescribed prior to index admission 1 = Not taking meds as prescribed prior to index admission	Control
Hospital & Unit Type	Hospital	Facility in which the unit resides from which the patient was discharged.	Categorical 1 = hospital A 2 = hospital B 3 = hospital C 4 = hospital D	Control
	Discharge Unit	Unit from which the HF patient was discharged	Categorical	Deleted
	Discharge Unit Type	The NDNQI classification of the unit from which the	Categorical 0 = Medical 1 = Med/Surgical 2 = Surgical	Control

Variable Category	Variable Name	Definition	Level of Measurement	Type of Variable
		patient was discharged.	3= Moderate Acuity 4 = Blended Acuity	
Treatments	Inpatient Teaching by Pharmacist	HF medication teaching provided by pharmacist in the hospital	Dichotomous 0 = No 1 = Yes	Control
	Transitional care Post-Discharge	Patient is receiving care from a transition coordinator or home care nurse within the 30 day transition after discharge.	Dichotomous 0 = No 1 = Yes	Control

Procedure

Data Extraction

The data was extracted by a research analyst employed by the healthcare system after approval was received by the University and the organization's Institutional Review Board (IRB). The analyst was provided specifications to guide data extraction including: (a) the date range of January 1, 2014 through June 30, 2015, (b) patient inclusion criteria and patient class, (c) patient exclusion codes, (d) hospital and units included in the analysis (d) definitions of independent, control, and dependent variables, (e) discharge disposition, (f) all discharge co-morbidity codes, (g) a cross hospital search for readmissions and ED visits across all 4 hospitals, and (h) readmission or ED visit primary diagnosis code and description. Decisions were also made regarding where the data

would be extracted. For example, the discharge co-morbidity codes were pulled from the billing system rather than the EHR.

Within the Epic system, each variable has an assigned a row number. The data analyst was provided a spreadsheet with the required variable columns and specific direction regarding which documented values were required and in what format as shown in the example illustrated in Table 3.6. The following example details the how the teaching intervention data was identified and extracted from the index hospitalization record.

Table 3.6 Example of Specifications Provided to Analyst by Variable

Variable Name	Definition	Level of Measurement	Integer	Collection Time	Label	Row Number
HF Discharge Teaching Component Provision	Documented provision of components of the fluid volume excess teaching plan during the course of the hospitalization which include:	Continuous	Count	Index admission - any occurrence	Causes of fluid volume excess	555000186
					Fluid volume excess treatment	824
					Symptom monitoring	833
					Na restriction	555000581
					Fluid restriction	825
					Overcoming barriers to adherence	555000107/830
					Diuretic titration	555000051/836

Pre-Analysis Data Coding, Screening, and Assumptions

A code book was created to identify, define, and establish a coding scheme for data entry of all variables. Data was provided to the primary investigator in a "comma separated values" or CSV file which was then exported to the statistical software. All exclusions were applied before the data was received. Discharge ICD-9 diagnostic codes

were collected for the first admission or observation stay incident during the date range. If the primary admission diagnosis for the inpatient / observation readmission or ED visit was HF, an occurrence of readmission or ED utilization was coded for index hospitalization outcome variable for this patient.

Summary measures, such as the Elixhauser co-morbidity score, have been demonstrated to be effective in capturing the significance of co-morbidities on patient burden of illness (Austin, Wong, Uzzo, Beck, & Egleston, 2013; Elixhauser et al., 1998). The HCUP Comorbidity Software (version 3.6) sponsored by the Agency for Healthcare Research and Quality (AHRQ) was utilized to transform the co-morbidities into an Elixhauser co-morbidity measure. The input data contained the billed discharge diagnosis related groups (DRG) and the diagnostic codes (ICD-9) for hospitalization. A binary code of 0 and 1 indicated the absence or presence of the co-morbidity for each patient record. The comorbidities were summed and the resulting co-morbidity measure was entered as a control variable.

Accuracy of input

Once data was exported into the statistical software (SAS®), consistency checks were performed to test for compatibility of the data within a case (Polit & Tatano Beck, 2012). Expected frequencies were examined for all categorical variables to assure the values corresponded to the coded values for the possible categories (Mertler & Vannatta, 2005). Categories with a small number of observations for each sub-category within the marital status, race, living situation, health literacy, and respiratory assessment were collapsed and combined as displayed in Table 3.5 (Pallant, 2013).

Missing Data

Descriptive statistics were run to determine the extent of missing data for each variable as well as the distribution of the missingness. Classification as a medical or surgical patient was not retained because during screening procedures it was identified that all patients were classified as medical patients within the database. The barrier to learning variable was deleted due to a large amount (69.1%) of missing data (Warner, 2013). An "unknown" category was created for missing documentation within the marital status and lives alone variables. A "not recorded" category was created for missing documentation within the health literacy, respiratory pattern, and medication non-adherence variables. Provision of teaching by a home care nurse during the 30 day post-discharge period was retained in the model but was combined with nurse outreach encounters (transitional care) when discovered there were only 2 cases with outreach encounters by a nurse documented within the 30 days of discharge.

Missing documentation of the HF discharge teaching variables were treated as teaching not provided. The ADL Index Score continuous variable was recoded as a categorical variable to account for cases with coding outside of the possible range and cases with missing data. Cases with an index score of 12 were placed in the "independent" category, cases with scores of 10–11 were placed in the "partially independent" category, cases with scores of 7–9 were placed in the "somewhat dependent" category, cases with scores of 1–6 were placed in the "highly dependent" category, and cases with scores outside the possible range or with missing documentation were placed in the "not recorded" category.

Linearity

Logistic regression does not have assumptions about the linear relationships among the predictor variables. Warner (2013) lists the assumptions for logistic regression as follows:

1. *"The outcome variable is dichotomous*
2. *Scores on the outcome variable must be statistically independent of each other*
3. *The model must be correctly specified: that is, it should include all relevant predictors, and it should not include any irrelevant predictors*
4. *The categories on the outcome variable are assumed to be exhaustive and mutually exclusive, that is, each person in the study is known to be a member of one group or the other but not both."* (p. 1008)

Outliers

The data file was screened for outliers and codes that are not possible (Polit & Tatano Beck, 2012). Since extreme values of predictor variables would have resulted in a model with a poor fit, a case with a length of stay of 99 days was removed from the analysis.

Multicollinearity

The predictor variables were examined for high inter-correlation by conducting collinearity diagnostics (Pallant, 2013). The predictor variables should be highly correlated to the dependent variable of hospital readmission but not to each other. The discharge unit effect was eliminated from the analysis due to a high correlation with the hospital location effect ($r = 0.72$). There was high correlation among the teaching component dose variables. Variables were selected for removal conceptually and

eliminated until all variables demonstrated a variance inflation factor (VIF) less than 10. The remaining unit type, hospital effect, and predictor variables were retained as they did not violate the assumption of multicollinearity. No assumptions are made regarding the distribution of scores in logistic regression (Pallant, 2013).

Statistical Procedures

Linear and logistic regression was utilized to answer the research questions. The first model examined the relationship between the aggregate component dose of discharge teaching exposure (standardized by entering the frequency of documented occurrences of all components of the fluid volume excess teaching plan during the entire index hospitalization and controlling for the length of the index hospitalization stay) and the dependent variable of an inpatient or observation readmission to any of the system's hospitals for HF within 30 days of a previous HF hospitalization discharge date while controlling for hospital and unit type effects, patient characteristics, clinical condition factors, exposure to inpatient teaching by a pharmacist prior, and transitional care. Consistent with the conceptual framework, all variables were entered into the analysis. The analysis was repeated using ED utilization within 30 days of a previous HF hospitalization discharge date without a concurrent admission as the dependent variable. The HF readmission and ED utilization models were run separately.

The second model examined if there were interactions between the clinical condition factors and patient characteristic variables and the aggregate component dose which then affected the outcome of readmission or post-discharge ED utilization. The interaction variables were identified by conducting a linear regression with the patient

characteristic and clinical condition variables as predictors and the aggregate component dose as the outcome variable. The interaction variables were then entered into the logistic regression analyses to identify if these variables modified the relationship between teaching dose and the outcome of readmission or ED utilization (Warner, 2013).

The remaining analysis utilized direct entry logistic regression to (1) examine the relationship between the documented dose of each of the seven hospital-required HF discharge teaching components within the HF teaching plan and hospital readmission or ED utilization within 30 days of a previous HF hospitalization discharge date; (2) identify how many of the 15 HF discharge teaching components occurred at any time during the hospitalization; and (3) explore the relationship between the dose of each of the 15 HF teaching components and readmission or ED utilization after controlling for patient characteristics, clinical condition factors, hospital and unit type effects, exposure to inpatient teaching by a pharmacist, and transitional care (Hosmer, Lemeshow, & Sturdivant, 2013).

A receiver operating characteristic curve (ROC) analysis was conducted to measure how well the model was able to correctly classify patients into the hospital readmission or no readmission groups (Polit & Yang, 2016). Two sensitivity analyses were then conducted to examine how well the model discriminated when patients with a without complication of care and patients who did not receive home care were compared to the full population.

Protection of Human Subjects

The research proposal was reviewed by the Institutional Review Board of Marquette University and the healthcare system. Data was extracted from the EHR by Research Analytics at the healthcare system after necessary IRB and administrative approvals. This included a data release negotiated between the Marquette IRB and the healthcare system. The human subjects for this study were HF patients greater than age 18. Patients > 90 years of age within the sample were coded as aged 90 in compliance with de-identification rules.

The patient level data was de-identified by the research analyst prior to data entry by the primary investigator. Patient names, admission and discharge dates, and medical record numbers were removed and each case was given a surrogate code. Hospital and units were coded by the primary investigator. The primary investigator retained the coding assignments in a secured file. All data files were stored on an encrypted flash drive with password protection. Access to the data was restricted to the primary investigator and the statistician. Due to the retrospective research design, there were no risks to the patient.

Strengths and Limitations of the Design

This retrospective correlational study utilized nursing data to describe the relationship between teaching interventions provided to the patient and the outcome of HF readmission or ED utilization within 30 days of a previous hospital discharge date. The design controlled for patient characteristics, clinical condition factors, unit type and

hospital effects which have been associated with hospital readmission. Exposure to inpatient teaching by pharmacists during the inpatient stay and by nurses during the 30 day transition period was also controlled for in the analysis. The outcome variable was the occurrence of HF specific readmissions or ED visits rather than all cause readmissions or ED visits unrelated to the previous HF hospitalization. Unlike other studies which have examined HF discharge teaching, this study explored essential components of an effective inpatient teaching plan and described how the dose of the HF teaching interventions contributed to avoidance of hospital readmission or post-discharge ED visits of HF patients.

This study design had limitations. The sample from this study was a cohort of HF patients which came from one healthcare system in the Midwest and may not have been representative of hospitals throughout the country. The outcome of hospital readmission may have been underestimated, as patients might have been readmitted to other hospitals outside of the healthcare system. Additionally, the data was limited to billing and encounter data in the healthcare system's EHR and the presence of all co-morbid conditions may not be coded for each patient.

This study did not measure the quality of the discharge teaching provided or family capacity to assist or monitor the patient. Additional transitional care other than care provided by a transition coordinator or a home care nurse may have occurred after discharge and this would not have been measured. In some instances, the patient may have received HF discharge teaching from a Dietician, Hospitalist or an Advanced Practice Nurse or Physician Assistant associated with a Physician practice and this would not have been captured because they do not document patient education in discrete fields.

Nurses may have been trained to provide and document on HF-1 core measures previously publicly reported even though the patient may already had possessed this knowledge. Finally, nurses may not have documented all the discharge teaching they provided during the course of care.

Summary

This chapter provided an overview of the study design, methods, and procedures utilized to answer the research questions. Study variables were identified and defined. Procedures for data extraction and screening were reviewed. Logistic regression and linear regression were the statistical tests performed to answer the research questions. The strengths and limitations of the study design were presented.

CHAPTER 4

RESULTS

This chapter contains a description of patient characteristics of the sample and results of the data analyses for the five research questions presented in Chapter 3. Logistic or linear regression analyses were used to answer the research questions. Area under the curve analysis results are reported to inform how well teaching component dose separated patients with hospital readmission from those not readmitted. Additionally, a model sensitivity analysis is presented which tested the model under the various conditions which might have affected the results.

Description of the Sample

The sample consisted of 1383 unique HF patients admitted to one of four hospitals of a large integrated healthcare system between the date range of January 1, 2014 through June 30th, 2015. Patients were included in the sample if they were discharged home with self-care (76%), discharged to home with home care (22.3%) or left the hospital against medical advice (1.7%). Of these patients, 305 (22.1%) were readmitted as an inpatient, 21 were readmitted as an observation patient (1.5%), and 123 (8.9%) experienced an Emergency Department (ED) visit for HF to one of the hospitals within the multihospital system within 30 days of discharge. A description of the patient characteristics and clinical condition factors of the HF patients in the sample are displayed in Table 4.1.

Table 4.1 Sample Characteristics (N = 1383)

Patient Demographics	N	%	Mean	SD
Age			66.6	13.7
Sex				
Female	621	44.9%		
Male	762	55.1%		
Race				
White	953	68.9%		
African American	388	28.1%		
Asian	16	1.2%		
Other	26	1.9%		
Ethnicity				
Hispanic	88	6.4%		
Marital Status				
Married	549	39.7%		
Single	643	46.5%		
Divorced	182	13.2%		
Unknown	9	0.7%		
Lives Alone				
No	894	64.6%		
Yes	325	23.5%		
Unknown	164	11.9%		
Health Literacy				
None at All	76	5.5%		
Somewhat / A Little	372	26.9%		
Extreme Health Literacy	565	40.9%		
Assessment Not Recorded	370	26.8%		
Clinical Condition Factors:				
Length of Stay			5.3	4.6

Elixhauser Co-morbidity Score			4.5	2.1
Patient Classification at Index Admission				
Inpatient	1305	94.4%		
Observation Patient	78	5.6%		
ADL Index Score				
Independent	1021	73.8%		
Partially Independent	67	4.8%		
Somewhat Dependent	124	9.0%		
Highly Dependent	52	3.8%		
Not Recorded	119	8.6%		
Respiratory Pattern				
Denies Shortness of Breath	255	18.4%		
Shortness of Breath with Rest	684	49.5%		
Shortness of Breath with Activity	390	28.2%		
Not Recorded	54	3.9%		
Medication Non-Adherence on Admission				
Taking as Prescribed	1281	92.6%		
Not Taking as Prescribed	83	6.0%		
Not Recorded	19	1.4%		
Prior Heart Failure Admission				
No	632	45.7%		
Yes	751	54.3%		
Post-Discharge Utilization Within 30 Days				
Inpatient Admission	305	22.1%		
Observation Admission	21	1.5%		
Emergency Department Visit	123	8.9%		

Research Question 1

What is the association between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days, after controlling for

clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

The first two regression analyses tested the association between hospital readmission or ED utilization within 30 days of discharge and the aggregate component dose of HF teaching documented by the nurse. Preliminary analysis was conducted to ensure the cell values were compatible with the expected range for each variable and correctly coded for the possible categories. All patients in the data set were classified as medical; therefore the medical or surgical variable was removed. The barriers to learning variables were removed due to an unacceptable amount of missing data. The discharge unit effect was eliminated from the analysis due to a high correlation with the hospital location effect ($r = 0.72$). There was one outlier case with a length of stay of 99 days which was eliminated. Other data preparation procedures are fully explained in Chapter 3.

Results of the logistic regression analyses are displayed in Table 4.2. There was a 2% higher likelihood of inpatient readmission with each one unit increase in the aggregate dose of HF teaching documented (odds ratio = 1.02, $p < .01$). The patient characteristic variable most significantly associated with an increased risk of inpatient readmission was a prior HF admission (odds ratio = 1.9, $p < .01$). The odds ratio for age was less than 1, indicating that for every one year of age above the sample mean of 66.6 years there was a 1% lower likelihood of a readmission occurrence (odds ratio = 0.99, $p = .05$). Patients who were partially independent in their activities of daily living were twice as likely to be readmitted (odds ratio = 2.0; $p = .05$) than patients who were independent in activities of daily living at time of hospital discharge and patients who were somewhat

dependent were 1.8 ($p < 0.01$) times more likely to be readmitted than patients who were independent. A longer length of stay also placed the HF patient at a 3% higher risk of readmission for every additional day above the mean of 5.3 days (odds ratio 1.03, $p = 0.05$).

No association was found between the aggregate dose of discharge teaching documented during the index hospitalization and ED utilization post-discharge. Two patient characteristic variables were related to ED utilization post discharge. Similar to the findings in the inpatient readmission model, for every year above the mean age of 66.6, there was a 2% lower likelihood of an ED visit post-discharge (odds ratio, 0.98, $p = 0.02$). Additionally, the likelihood of an ED visit was 1.6 times higher for patients who had experienced a prior HF hospitalization ($p = 0.03$). There were no associations between the ADL Index score or length of stay and ED utilization as demonstrated in the inpatient hospital readmission model.

Table 4.2 Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship between the Likelihood of HF Readmission and ED Utilization within 30 Days of Discharge and the Aggregate Counts of All Teaching and All HF Discharge Specific Teaching Documented During the Index Hospitalization, N = 1383

	IP Readmission		ED Utilization	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
HF Aggregate Teaching Dose	1.02	(1.01 - 1.03)**	1.00	(0.98 - 1.02)
Observation Patient	1.28	(0.69 – 2.36)	0.66	(0.26 – 1.70)
ADL Index Score				
Partially Independent	1.81	(1.03 – 3.20)*	1.17	(0.52 – 2.63)
Somewhat Dependent	1.98	(1.27 – 3.11)**	1.40	(0.76 – 2.59)
Highly Dependent	1.40	(0.71 – 2.74)	0.36	(0.08 – 1.58)
Respiratory Pattern				
Short of Breath at Rest	1.09	(0.75 – 1.59)	1.05	(0.61 –1.81)
Short of Breath with Activity	1.25	(0.83 – 1.87)	0.91	(0.50 – 1.67)
Medication Non-Adherence	1.18	(0.68 – 2.05)	1.76	(0.89 – 3.49)

Elixhauser Co-Morbidity Score	1.05	(0.98 – 1.12)	1.09	(0.99 – 1.20)
Prior HF Admission	1.89	(1.43 – 2.52)**	1.59	(1.05 – 2.41)*
Length of Stay	1.03	(1.00 – 1.06)*	0.98	(0.93 – 1.04)
Age	0.99	(0.98 – 1.00)*	0.98	(0.97 – 1.00)*
Male	1.18	(0.90 – 1.56)	1.09	(0.73 – 1.63)
Race				
Black	0.82	(0.56 – 1.23)	1.25	(0.73 – 2.17)
Asian	1.48	(0.47 – 4.70)	0.61	(0.07 – 4.96)
Other	0.46	(0.15 – 1.45)	0.00	
Ethnicity				
Patient is Hispanic	1.16	(0.68 - 1.98)	0.85	(0.36 – 1.99)
Marital Status				
Single	1.35	(0.96 – 1.89)	1.34	(0.81 – 2.21)
Divorced	1.30	(0.83 – 2.05)	1.35	(0.70 – 2.58)
Patient Lives Alone	1.20	(0.85 – 1.70)	1.01	(0.61 – 1.68)
Health Literacy				
Somewhat / A Little	1.00	(0.53 – 1.87)	0.87	(0.36 – 2.12)
Extreme / Quite a Bit	1.10	(0.59 – 2.05)	0.56	(0.23 – 1.39)
Inpatient Pharmacy Teaching	1.04	(0.43 – 2.54)	0.34	(0.04 – 2.61)
Transitional care Post-Discharge	0.98	(0.69 – 1.38)	0.83	(0.48 – 1.43)

The model contains controls for hospital and unit-type effects (not reported in the table).
*$p < .05$, **$p < .01$

Research Question 2

Do patient characteristics and clinical condition factors moderate the relationship between the dose of HF teaching documented in the hospital and HF readmission or ED utilization within 30 days after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

A linear regression procedure was conducted to identify relationships between the patient characteristic variables and the aggregate dose of HF teaching documented. Four variables had significant associations. These were prior HF readmission ($\beta = 0.09$, $p =$

0.001), health literacy (β = -0.11, $p < 0.001$), and the Elixhauser co-morbidity score (β = 0.06, $p = 0.03$). Interaction variables were created for each of these variables. To determine if these patient characteristics modified the effect of the dose of HF teaching on hospital readmission a two-step process was conducted to investigate the relationship of the dose of HF teaching and each significant patient characteristic variable with and without the interaction variable. The results of the interaction models are displayed in Tables 4.3- 4.5. The addition of the interaction terms did not result in statistical interactions between the patient characteristic variables of prior HF admission, health literacy, and the Elixhauser co-morbidity score and the aggregate dose of HF teaching. When the models were repeated with ED utilization as the outcome variable, the results were the same. None of the interaction variables reached significance.

Table 4.3 Estimated Logistic Regression Coefficients, Standard Errors, Wald Statistics, *p* – Values and 95% CIs from Models Showing Statistical Adjustment and Statistical Interaction from the Addition of a Prior HF Admission x Aggregate Teaching Dose Interaction Variable to Test for Moderating Effect on the Outcome of Hospital Readmission, N = 1383.

Model	Variable	Estimate	Standard Error	Wald	Sig
1	Prior HF Admission	0.639	0.145	19.49	<0.001**
	Aggregate Teaching Dose	0.020	0.006	12.00	<0.001**
	Constant	-1.594	0.658	5.86	0.01
2	Prior HF Admission	0.730	0.210	12.03	0.04*
	Aggregate Teaching Dose	0.013	0.011	1.43	0.23
	Prior HF Admission *Aggregate Teaching Dose	-0.004	0.005	0.482	0.49
	Constant	-1.728	0.7537	5.25	0.02

The model contains controls for patient characteristics, clinical condition factors, hospital and unit-type effects, pharmacy teaching, and transitional care (not reported in the table).
*$p < .05$, **$p < .01$

Table 4.4 Estimated Logistic Regression Coefficients, Standard Errors, Wald Statistics, *p* – Values and 95% CIs from Models Showing Statistical Adjustment and Statistical Interaction from the Addition of a Health Literacy x Aggregate Teaching Dose Interaction Variable to Test for Moderating Effect on the Outcome of Hospital Readmission, N = 1383.

Model	Variable	Estimate	Standard Error	Wald	Sig
1	Health Literacy				
	Somewhat / A Little	0.000	0.319	0.00	1.00
	Extreme / Quite a Bit	0.097	0.318	0.093	0.76
	Aggregate Teaching Dose	0.007	0.002	10.75	0.001**
	Constant	-1.594	0.658	5.86	0.01
2	Health Literacy				
	Somewhat / A Little	0.125	0.474	0.070	0.79
	Extreme / Quite a Bit	0.031	0.470	0.004	0.95
	Aggregate Teaching Dose	0.013	0.011	1.43	0.23
	Aggregate Teaching Dose*Somewhat / A Little	-0.004	0.010	0.010	0.67
	Aggregate Teaching Dose*Extreme / Quite a Bit	0.001	0.010	0.010	0.87
	Constant	-1.728	0.754	5.256	0.02

The model contains controls for patient characteristics, clinical condition factors, hospital and unit-type effects, pharmacy teaching, and transitional care (not reported in the table). *$p < .05$, **$p < .01$

Table 4.5 Estimated Logistic Regression Coefficients, Standard Errors, Wald Statistics, *p* – Values and 95% CIs from Models Showing Statistical Adjustment and Statistical Interaction from the Addition of an Elixhauser x Aggregate Teaching Dose Interaction Variable to Test for Moderating Effect on the Outcome of Hospital Readmission, N = 1383.

Model	Variable	Estimate	Standard Error	Wald	Sig
1	Elixhauser Co-Morbidity Score	0.055	0.033	2.81	0.09
	Aggregate Teaching Dose	0.007	0.002	10.75	0.001**
	Constant	-1.594	0.658	5.86	0.01

2	Elixhauser Co-Morbidity Score	0.056	0.045	1.54	0.21
	Aggregate Teaching Dose	0.013	0.011	1.43	0.23
	Elixhauser Index * Aggregate Teaching Dose	0.000	0.001	0.005	0.94
	Constant	-1.728	0.754	5.26	0.02

The model contains controls for patient characteristics, clinical condition factors, hospital and unit-type effects, pharmacy teaching, and transitional care (not reported in the table).
*$p < .05$, **$p < .01$

Research Question 3

What is the relationship between the dose of the seven hospital-required HF discharge teaching components included in the HF teaching plan and hospital readmission or ED utilization of HF patients within 30 days of discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

The next analyses tested the relationship between the documented dose of the seven hospital-required HF discharge teaching components in the HF teaching plan and hospital readmission. Although there was multicollinearity among the discharge specific teaching components, all were entered into this analysis. The results are displayed in Table 4.6. Removing highly correlated discharge teaching components in this analysis would have left the activity level, follow-up and overcoming barriers variables; none of which were significant in the regression analyses. Later, when examining the dose of all 15 components in the fluid volume excess teaching plan, variables were conceptually selected and eliminated until the assumption of multicollinearity was met.

There were significant associations between hospital readmission and the dose of two of the HF discharge teaching components documented. For each additional documented exposure to the weight monitoring component, patients were more likely (odds ratio = 1.2, $p < .01$) to be readmitted to the hospital. With every additional documented provision of diet and fluid intake teaching, patients were 1.7 times less likely to be readmitted (odds ratio = 0.58, $p = .02$). The significant patient characteristics associated with readmission were unchanged from model 4.2 except for age, which did not reach significance.

HF teaching component dose was not associated with ED utilization within 30 days of discharge. Age and a prior HF admission were the only significant predictors in the discharge teaching component dose and ED utilization model.

Table 4.6 Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship Between the Likelihood of Readmission and ED Utilization Within 30 Days of Discharge and the Dose of Each HF Discharge Specific Teaching Component Documented During the Index Hospitalization, N = 1383

	IP Readmission		ED Utilization	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
Discharge Weight Monitoring	1.20	(1.09 – 1.33)**	0.76	(0.38 – 1.51)
Discharge Activity Level	1.09	(0.70 – 1.68)	0.84	(0.41 – 1.73)
Discharge Diet / Fluid Intake	0.58	(0.37 – 0.92)*	0.84	(0.41 – 1.75)
Discharge Medication Teaching	1.42	(0.90 – 2.25)	1.42	(0.71 – 2.85)
Discharge Overcoming Barriers	0.84	(0.70 – 1.02)	0.84	(0.60 – 1.17)
Discharge Follow-up	1.12	(0.77 – 1.65)	0.97	(0.56 – 1.66)
Discharge Symptoms Worsening	1.00	(0.62 – 1.63)	1.40	(0.64 – 3.08)
Observation Patient	1.26	(0.68 – 2.35)	0.65	(0.25 – 1.69)
ADL Index Score				
Partially Independent	1.92	(1.08 – 3.41)*	1.17	(0.52 – 2.64)
Somewhat Dependent	1.96	(1.25 – 3.08)**	1.39	(0.75 – 2.58)
Highly Dependent	1.41	(0.72 – 2.78)	0.37	(0.08 – 1.60)

Respiratory Pattern				
Short of Breath at Rest	1.08	(0.74 – 1.58)	1.05	(0.60 – 1.81)
Short of Breath with Activity	1.28	(0.85 – 1.92)	0.92	(0.50 – 1.70)
Medication Non-Adherence	1.17	(0.67 – 2.05)	1.72	(0.86 – 3.42)
Elixhauser Co-Morbidity Score	1.05	(0.98 – 1.12)	1.09	(0.98 – 1.20)
Prior HF Admission	1.86	(1.39 – 2.48)**	1.54	(1.02 – 2.34)*
Length of Stay	1.04	(1.00 – 1.07)*	0.99	(0.93 – 1.04)
Age	0.99	(0.98 –1.00)	0.98	(0.97 – 1.00)*
Male	1.17	(0.89 – 1.55)	1.09	(0.73 – 1.62
Race				
Black	0.83	(0.56 – 1.24)	1.29	(0.74 – 2.24)
Asian	1.48	(0.45 – 4.83)	0.59	(0.07 – 4.94)
Other	0.50	(0.16 – 1.55)	0.00	
Ethnicity				
Patient is Hispanic	1.20	(0.70 – 2.06)	0.86	(0.48 – 1.45)
Marital Status				
Single	1.33	(0.94 – 1.87)	1.29	(0.78 – 2.14)
Divorced	1.25	(0.79 – 1.97)	1.28	(0.66 – 2.46)
Patient Lives Alone	1.85	(0.84 – 1.67)	1.04	(0.62 – 1.72)
Health Literacy				
Somewhat / A Little	1.07	(0.57 – 2.01)	0.87	(0.36 – 2.14)
Extreme / Quite a bit	0.90	(0.46 – 1.76)	0.56	(0.23 – 1.40)
Inpatient Teaching by Pharmacist	1.10	(0.45 – 2.74)	0.33	(0.04 – 2.59)
Transitional care Post-Discharge	1.00	(0.71 – 1.42)	0.82	(0.47 – 1.42)

The model contains controls for hospital and unit-type effects (not reported in the table).
*$p < .05$, **$p < .01$

Research Question 4

How many HF teaching components are needed to reduce the risk of HF readmission or ED utilization within 30 days of hospital discharge after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists, and transitional care?

This analysis tested the relationship between teaching component count (number of components of the fluid volume excess teaching plan documented as received during the index hospitalization) and hospital readmission or ED utilization. The results are displayed in Table 4.7. No significant association was found between component completion and inpatient readmission within 30 days of discharge. As in the first model, the patient characteristics of age, length of stay, prior HF admission and functional status retained significance.

The model was repeated utilizing ED utilization within 30 days of discharge as the dependent variable. No significant association was found between teaching component completion and the outcome of ED utilization. Prior HF admission and age were the patient characteristics which retained significance in this model.

Table 4.7 Model 1: Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship Between the Likelihood of Readmission and ED Utilization Within 30 Days of Discharge and Completed HF Teaching Component Count Documented During the Index Hospitalization, N = 1383

	IP Readmission		ED Utilization	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
HF Teaching Component Count	1.02	(0.99 – 1.05)	1.01	(0.97 – 1.05)
Observation Patient	1.26	(0.68 – 2.31)	0.67	(0.26 – 1.72)
ADL Index Score				
Partially Independent	1.87	(1.06 – 3.30)*	1.42	(0.77 – 2.62)
Somewhat Dependent	2.00	(1.28 –	1.20	(0.53 – 2.70)
Highly Dependent	1.38	3.13)**	0.36	(0.08 – 1.58)
		(0.70 – 2.71)		
Respiratory Pattern				
Short of Breath at Rest	1.10	(0.75 – 1.59)	1.05	(0.61 – 1.81)
Short of Breath with Activity	1.22	(0.82 – 1.82)	0.91	(0.50 – 1.67)
Medication Non-Adherence	1.17	(0.67 – 2.02)	1.76	(0.89 – 3.48)
Elixhauser Co-Morbidity Score	1.05	(0.98 – 1.12)	1.09	(0.99 – 1.21)
Prior HF Admission	1.94	(1.47 – 2.58)**	1.59	(1.05 – 2.41)*
Length of Stay	1.03	(1.00 – 1.07)*	0.98	(0.93 – 1.04)
Age	0.99	(0.98 – 1.00)*	0.98	(0.97 – 1.00)*

Male	1.20	(0.91 – 1.58)	1.09	(0.74 – 1.63)
Race				
Black	0.82	(0.55 – 1.21)	1.25	(0.72 – 2.16)
Asian	1.56	(0.49 – 4.93)	0.60	(0.07 – 4.93)
Other	0.46	(0.15 – 1.43)	0.00	
Ethnicity				
Hispanic	1.19	(0.70 – 2.02)	0.86	(0.37 – 2.00)
Marital Status				(0.81 – 2.20)
Single	1.34	(0.95 – 1.88)	1.33	(0.70 – 2.59)
Divorced	1.33	(0.85 – 2.08)	1.35	
Patient Lives Alone	1.23	(0.87 – 1.73)	1.02	(0.61 – 1.69)
Health Literacy				
Somewhat / A Little	1.00	(0.53 – 1.86)	0.87	(0.36 – 2.12)
Extreme / Quite a Bit	1.09	(0.58 – 2.02)	0.56	(0.23 – 1.39)
Inpatient Teaching by Pharmacist	1.22	(0.52 – 2.89)	0.33	(0.04 – 2.58)
Transitional care Post-Discharge	0.98	(0.70 – 1.38)	0.33	(0.48 – 1.43)

The model contains controls for hospital and unit-type effects (not reported in the table). *$p < .05$, **$p < .01$

Research Question 5

Which components of the HF teaching plan, when provided together, are associated with a decreased probability of HF readmission or ED utilization after controlling for clinical condition factors, patient characteristics, hospital and unit type effects, inpatient teaching provided by pharmacists and transitional care?

In this model, the frequency of documented teaching occurrences for each teaching component aggregated over the length of the index hospitalization was used as a predictor rather than the component count. Most teaching components were documented once, so to better understand the HF teaching components observed dosage frequency, a categorical variable was created (Dose = 0, 1, and 2 or more exposures). The dose categories for each teaching component, the associated proportion of cases experiencing readmission or ED utilization, and significance values are displayed in Table 4.8.

Table 4.8: Teaching Component Dose, Percent Readmission and ED Utilization within 30 Days of Index Hospitalization Discharge, and Chi-Square *p* – Values (*$p < .05$).

Teaching Component Dose	N 1383	Readmission No	Readmission Yes	Sig	ED Visit No	ED Visit Yes	Sig
HF Fluid Excess							
0	226	77.6%	22.4%		90.2%	9.8%	
1	463	78.2%	21.8%		88.6%	11.4%	
2+	694	75.4%	24.6%	0.51	93.7%	6.3%	0.01*
HF Fluid Volume Excess Treatment							
0	232	79.1%	20.9%		90.2%	9.9%	
1	487	78.3%	21.7%		88.3%	11.7%	
2+	664	75.0%	25.0%	0.28	93.5%	6.5%	0.06
HF Symptom Monitoring							
0	232	80.6%	19.4%		90.0%	9.8%	
1	487	77.6%	22.4%		89.0%	11.0%	
2+	664	75.0%	25.0%	0.19	92.9%	7.1%	<0.01*
Sodium Restriction							
0	256	79.3%	20.7%		89.8%	10.2%	
1	509	77.0%	23.0%		89.2%	10.8%	
2+	618	75.7%	24.3%	0.52	93.2%	6.8%	0.05*
Fluid Restriction							
0	408	78.9%	21.1%		90.2%	9.8%	
1	402	79.6%	20.4%		90.0%	10.0%	
2+	573	73.5%	26.5%	0.04*	92.5%	7.5%	0.31
Overcoming Barriers							
0	380	78.2%	21.8%		91.6%	8.4%	
1	543	78.1%	21.9%		88.8%	11.2%	
2+	460	74.3%	25.7%	0.29	93.5%	6.5%	0.03*
Diuretic Titration							
0	526	78.5%	21.5%		90.7%	9.3%	
1	426	77.5%	22.5%		88.0%	12.0%	
2+	431	74.2%	25.8%	0.28	94.7%	5.3%	<0.01*
Outpatient Resources							
0	378	77.0%	23.0%		92.0%	8.0%	
1	564	78.5%	21.5%		88.8%	11.2%	
2+	432	74.5%	25.5%	0.33	93.3%	6.7%	0.04*
HF Specific Causes							
0	293	80.2%	19.8%		89.4%	10.6%	
1	567	76.9%	23.1%		90.3%	9.7%	
2+	523	75.0%	25.0%	0.23	92.9%	7.1%	0.16

Discharge Weight Monitoring							
0	282	80.9%	19.1%		89.4%	10.6%	
1	545	77.1%	22.9%		90.5%	9.5%	
2+	556	74.6%	25.4%	0.13	92.6%	7.4%	0.23
Discharge Activity Level							
0	292	80.1%	19.9%		89.4%	10.6%	
1	564	77.3%	22.7%		90.8%	9.2%	
2+	527	74.6%	25.4%	0.18	92.4%	7.6%	0.32
Discharge Diet / Fluid Intake							
0	339	77.0%	23.0%		90.3%	9.7%	
1	514	78.2%	21.8%		90.1%	9.9%	
2+	530	75.5%	24.5%	0.58	92.6%	7.4%	0.28
Discharge Medication Teaching							
0	343	77.8%	22.2%		90.1	9.9%	
1	526	78.9%	21.1%		90.7	9.3%	
2+	514	74.1%	25.9%	0.17	92.2	7.8%	0.51
Discharge Follow-up							
0	363	77.4%	22.6%		90.6%	9.4%	
1	536	79.3%	20.7%		90.1%	9.9%	
2+	484	73.8%	26.2%	0.11	92.6%	7.4%	0.36
Discharge Symptoms Worsening							
0	295	79.3%	20.7%		89.8%	10.2%	
1	566	78.1%	21.9%		90.5%	9.5%	
2+	522	74.1%	25.9%	0.16	92.5%	7.5%	0.33

Upon examination of each of the teaching component dose categories, there were significant associations between receiving one dose and ED visits and 2 or more doses of the fluid volume excess, symptom monitoring, sodium restriction, overcoming barriers, diuretic titration, and outpatient resource teaching components and the occurrence of ED utilization post-discharge. There was a significant association between receiving one dose and readmission and two or more doses of the fluid restriction teaching component and the occurrence of an inpatient readmission.

As previously noted, many of the teaching component dose variables were highly correlated. For this analysis, teaching components were conceptually selected and removed until all remaining variables had a variance inflation factor (VIF) less than 10. When the dose of each of the remaining HF teaching components were added to the model, there were significant associations between the dose of component teaching and hospital readmission for two components (Table 4.9). For each additional unit of activity level teaching documented, patients were 1.23 times more likely to experience a hospital readmission (p = .05). For every unit increase of documented sodium restriction teaching exposure, patients were 1.3 times less likely to experience a readmission occurrence (odds ratio = 0.78, p = .03).

The component dose model was repeated with ED utilization within 30 days of discharge as the dependent variable. Fluid restriction teaching was associated with increased odds of ED utilization post-discharge by a factor of 1.27 (p < .01). For every additional unit of diuretic titration teaching exposure, patients were 1.6 times less likely to experience an ED admission within the 30 day post-discharge period (odds ratio = 0.64, p= .01).

Table 4.9: Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship Between the Likelihood of Hospital Readmission Within 30 Days of Discharge and the Dose of Each HF Teaching Component Documented During the Index Hospitalization, N = 1383

	IP Readmission		ED Utilization	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
HF Fluid Excess	0.88	(0.71 – 1.09)	0.73	(0.50 – 1.07)
HF Symptom Monitoring	1.18	(0.97 – 1.44)	1.11	(0.81 – 1.52)
Sodium Restriction	0.78	(0.62 – 0.97)*	0.87	(0.61 – 1.23)
Fluid Restriction	1.11	(0.99 – 1.24)	1.27	(1.06 – 1.52)**
Diuretic Titration	1.06	(0.86 – 1.29)	0.64	(0.45 – 0.92)*
HF Outpatient Resources	0.84	(0.65 – 1.09)	1.63	(0.99 – 2.68)
HF Specific Causes	1.03	(0.79 – 1.35)	0.92	(0.59 – 1.46)

Discharge Activity Level	1.23	(1.00 – 1.51)*	1.01	(0.73 – 1.41)
Observation Patient	1.26	(0.68 – 2.31)	0.63	(0.24 – 1.64)
ADL Index Score				
Partially Independent	1.89	(1.07 – 3.33)*	1.12	(0.48 – 2.55)
Somewhat Dependent	1.92	(1.22 – 3.02)**	1.42	(0.76 – 2.65)
Highly Dependent	1.40	(0.71 – 2.77)	0.40	(0.09 – 1.74)
Respiratory Pattern				
Short of Breath at Rest	1.09	(0.75 – 1.58)	1.07	(0.62 – 1.87)
Short of Breath with Activity	1.22	(0.81 – 1.83)	0.95	(0.52 – 1.76)
Medication Non-Adherence	1.21	(0.69 – 2.09)	1.62	(0.81 – 3.25)
Elixhauser Co-Morbidity Score	1.05	(0.98 – 1.12)	1.09	(0.99 – 1.21)
Prior HF Admission	1.97	(1.48 – 2.62)**	1.63	(1.07 – 2.49)*
Length of Stay	1.03	(0.99 – 1.06)	0.98	(0.93 – 1.04)
Age	0.99	(0.98 – 1.00)	0.98	(0.97 – 1.00)*
Male	1.19	(0.90 – 1.57)	1.05	(0.71 – 1.57)
Race & Ethnicity				
Black	0.82	(0.55 – 1.22)	1.26	(0.72 – 2.21)
Asian	1.48	(0.47 – 4.71)	0.64	(0.08 – 5.52)
Other	0.45	(0.14 – 1.40)	0.00	
Ethnicity				
Hispanic	1.18	(0.69 – 2.02)	0.82	(0.35 – 1.94)
Marital Status				
Single	1.39	(0.98 – 1.94)	1.35	(0.82 – 2.23)
Divorced	1.33	(0.85 – 2.09)	1.28	(0.66 – 2.48)
Patient Lives Alone	1.20	(0.85 – 1.69)	1.02	(0.61 – 1.70)
Health Literacy				
Somewhat / A Little	1.01	(0.54 – 1.89)	0.82	(0.33 – 2.01)
Extreme / Quite a Bit	1.11	(0.59 – 2.08)	0.53	(0.21 – 1.32)
Inpatient Teaching by a Pharmacist	1.21	(0.50 – 2.91)	0.29	(0.04 – 2.31)
Transitional care Post-Discharge	0.97	(0.69 – 1.37)	0.81	(0.46 – 1.41)

The model contains controls for hospital and unit-type effects (not reported in the table).
*$p < .05$, **$p < .01$

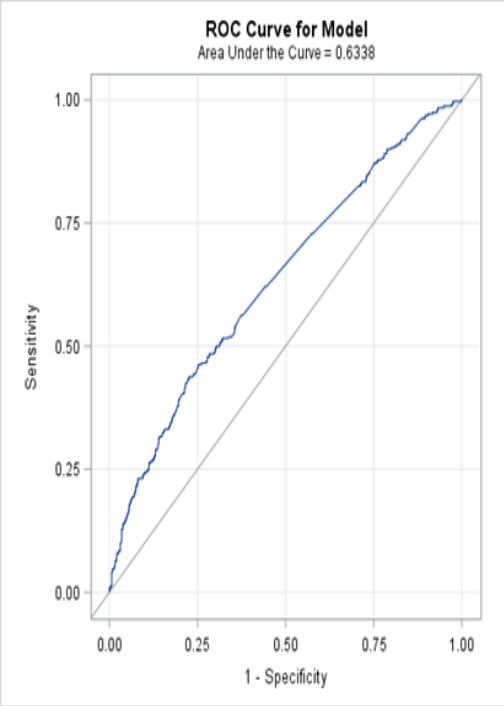
Receiver Operating Characteristic Curve Results

A receiver operating characteristic (ROC) curve analysis was performed to assess how well model variables predicted readmission or non-readmission event occurrence.

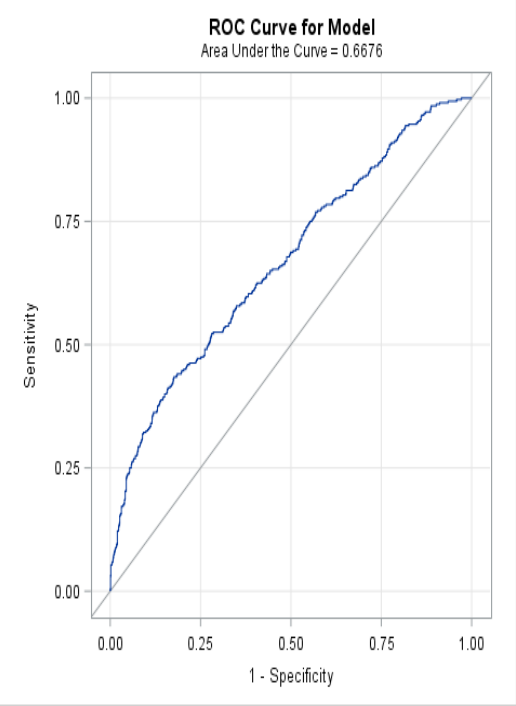
The c-statistic or area under the curve for the component dose models with and without control variables are displayed in Figures 4.1 and 4.2. The inclusion of control variables improved predictive performance of the inpatient readmission model from 63% (c statistic 0.634) to 67% (c statistic 0.668). Similarly, the ED utilization model with control variables (c statistic 0.715) performed better than the teaching component variable only model (0.629).

Figure 4.1 ROC Curves for Model: Analysis of the Relationship between the Likelihood of Hospital Readmission within 30 Days of Discharge and the Dose of Each HF Teaching Component Documented During the Index Hospitalization

ROC Curve A



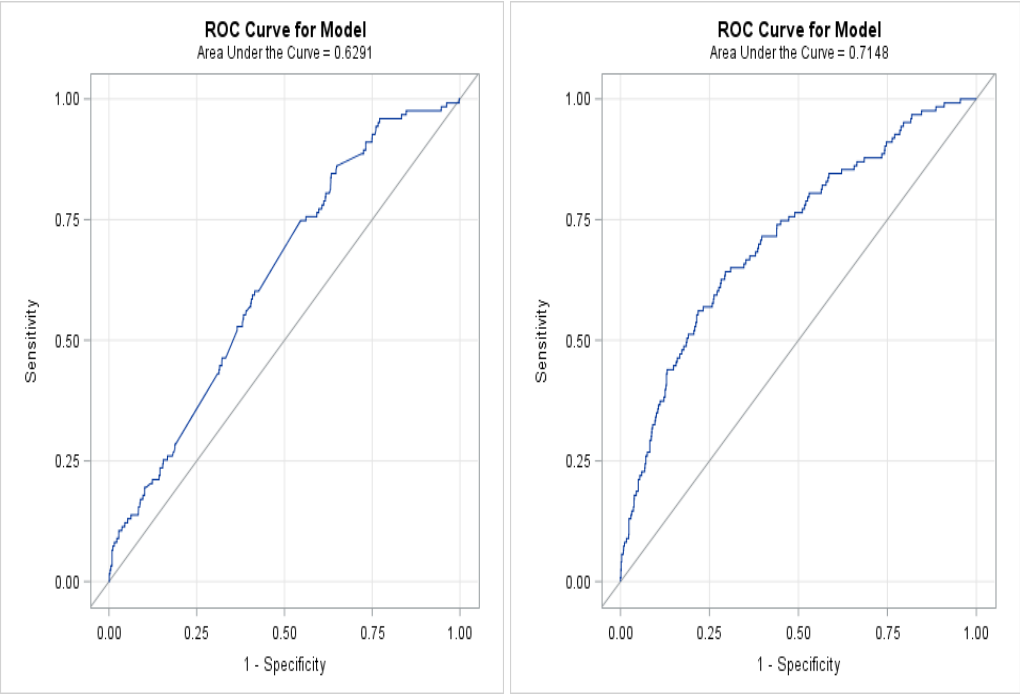
ROC Curve B



ROC Curve A: The model contains teaching variables with no control variables.
ROC Curve B: The model contains controls for patient characteristics, clinical condition factors, hospital and unit-type effects, pharmacy teaching, and transitional care.

Figure 4.2 ROC Curves for Model: Analysis of the Relationship between the Likelihood of ED Utilization within 30 Days of Discharge and the Dose of Each HF Discharge Specific Teaching Component Documented During the Index Hospitalization

ROC Curve A ROC Curve B



ROC Curve A: The model contains teaching variables with no control variables
ROC Curve B: The model contains controls for patient characteristics, clinical condition factors, hospital and unit-type effects, pharmacy teaching, and transitional care.

The multivariate model which included the aggregate teaching component dose performed better than the model which utilized the dose of each of the teaching components included in the HF fluid volume excess teaching plan in predicting an inpatient readmission event. The all component dose model repeated with ED admission within 30 days of discharge as the outcome variable discriminated better than the inpatient readmission model and was superior to all other ED utilization models. The comparisons of all model statistics are displayed in Table 4.10.

Table 4.10 Receiver Operating Characteristic Curve Area Results of the Likelihood of Hospital Readmission and ED Utilization within 30 Days of Discharge and the Dose of Each HF Discharge Teaching Component Model

Model	IP or Observation Admission within 30 days	ED visit within 30 days
All Teaching Components Dose (without controls)	0.634	0.629
Aggregate Teaching Component Dose	0.672	0.697
Interaction Model	0.675	0.696
Discharge Teaching Components Dose	0.685	0.704
Number of Components Completed	0.665	0.696
Teaching Components Dose	0.668	0.715

Sensitivity Analysis

Fluid and electrolyte imbalance is a co-morbid condition associated with complications of care (DeVore et al., 2014). A sensitivity analysis was conducted to examine model performance in patients without the presence of the fluid and electrolyte imbalance co-morbidity compared to the full population (Table 4.11). The model remained stable with regard to the teaching component variables. The sodium restriction and activity level variables maintained significance in the no fluid and electrolyte imbalance co-morbidity model; no different than in the full population. The patients in the subset without the fluid and electrolyte co-morbidity differed from the full population with regard to patient characteristics and clinical condition. Unlike the full population model, patients without the fluid and electrolyte co-morbidity who were partially independent had the same likelihood of a readmission outcome as the rest of the sample. Patients were more likely to be readmitted if they had a length of stay longer than the mean or were unmarried. Model discrimination improved when the no fluid and electrolyte complication patient subset was separated and compared to the full population model (Table 4.13).

Table 4.11: Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship Between the Likelihood of Hospital Readmission Within 30 Days of Discharge and the Dose of Each HF Discharge Specific Teaching Components Documented During the Index Hospitalization

No Fluid & Electrolyte Imbalance	IP Readmission No Fluid & Electrolyte Imbalance (N = 871)		IP Readmission Full Sample Population (N = 1381)	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
HF Fluid Excess	1.05	(0.77 – 1.43)	0.88	(0.71 – 1.09)
HF Symptom Monitoring	1.01	(0.77 – 1.33)	1.18	(0.97 – 1.44)
Sodium Restriction	0.71	(0.52 – 0.97)*	0.78	(0.62 – 0.97)*
Fluid Restriction	1.03	(0.86 – 1.23)	1.11	(0.99 – 1.24)
Diuretic Titration	1.12	(0.83 – 1.49)	1.06	(0.86 – 1.29)
HF Outpatient Resources	0.82	(0.56 – 1.19)	0.84	(0.65 – 1.09)
HF Specific Causes	1.04	(0.71 – 1.52)	1.03	(0.79 – 1.35)
Discharge Activity Level	1.47	(1.09 – 1.99)*	1.23	(1.00 – 1.51)*
ADL Index Score				
Partially Independent	1.43	(0.66 – 3.09)	1.89	(1.07 – 3.33)*
Somewhat Dependent	2.39	(1.29 – 4.46)**	1.92	(1.22 – 3.02)**
Highly Dependent	1.52	(0.59 – 3.95)	1.40	(0.71 – 2.77)
Respiratory Pattern				
Short of Breath at Rest	0.78	(0.48 – 1.28)	1.09	(0.75 – 1.58)
Short of Breath with Activity	1.14	(0.69 – 1.90)	1.22	(0.81 – 1.83)
Medication Non-Adherence	1.35	(0.66 – 2.76)	1.21	(0.69 – 2.09)
Elixhauser Co-Morbidity	1.05	(0.95 – 1.17)	1.05	(0.98 – 1.12)
Score	1.05	(0.95 – 1.17)	1.05	(0.98 – 1.12)
Prior HF Admission	1.71	(1.18 – 2.46)*	1.97	(1.48 – 2.62)**
Length of Stay	1.06	(1.00 – 1.12)*	1.03	(0.99 – 1.06)
Age	0.99	(0.97 – 1.00)	0.99	(0.98 – 1.00)
Male	1.28	(0.88 – 1.85)	1.19	(0.90 – 1.57)
Race				
Black	0.64	(0.37– 1.10)	0.82	(0.55 – 1.22)
Asian	5.00	(0.94 – 26.58)	1.48	(0.47 – 4.71)
Other	0.45	(0.09 – 2.24)	0.45	(0.14 – 1.40)
Ethnicity				
Hispanic	1.06	(0.50 – 2.23)	1.18	(0.69 – 2.02)
Marital Status				
Single	1.76	(1.13 – 2.75)*	1.39	(0.98 – 1.94)
Divorced	1.90	(1.02 – 3.54)*	1.33	(0.85 – 2.09)
Patient Lives Alone	1.00	(0.63 – 1.59)	1.20	(0.85 – 1.69)
Health Literacy				
Somewhat / A Little	1.04	(0.48 – 2.25)	1.01	(0.54 – 1.89)
Extreme / Quite a Bit	1.21	(0.56 – 2.62)	1.11	(0.59 – 2.08)
Inpatient Teaching by a Pharmacist	1.55	(0.58 – 4.17)	1.21	(0.50 – 2.91)

Transitional care Post-Discharge	1.00	(0.62 – 1.60)	0.97	(0.69 – 1.37)

The model contains controls for hospital and unit-type effects (not reported in the table).
*$p < .05$, **$p < .01$

A second sensitivity analysis was conducted to compare patients who had been discharged to home without home care to the full population model. The results are displayed in table 4.12. The sodium restriction and activity level variables lost significance in the model. There were some differences expected in patient characteristics. Similar to the subset of patients without the fluid and electrolyte co-morbidity, patients discharged to home without home care who were partially independent were not at risk for readmission. They were 1.1 times more likely to be readmitted with each additional unit increase on the Elixhauser co-morbidity score above the mean of 4.5. The patients discharged home without home care model discriminated slightly better (c statistic 0.683) than the full population model. The results of the sensitivity analyses are displayed in Table 4.13.

Table 4.12: Odds Ratios (and 95% Confidence Intervals) From Logistic Regression Analysis of the Relationship Between the Likelihood of Hospital Readmission Within 30 Days of Discharge and the Dose of Each HF Discharge Specific Teaching Components Documented During the Index Hospitalization

Home Without Home Care	IP Readmission Home Without Home Care (N = 1072)		IP Readmission Full Sample Population (N = 1381)	
Variable	Odds	Ratio (95% Cl)	Odds	Ratio (95% Cl)
HF Fluid Excess	0.85	(0.65 – 1.11)	0.88	(0.71 – 1.09)
HF Symptom Monitoring	1.02	(0.79 – 1.32)	1.18	(0.97 – 1.44)
Sodium Restriction	0.95	(0.71 – 1.26)	0.78	(0.62 – 0.97)*
Fluid Restriction	1.08	(0.93 – 1.26)	1.11	(0.99 – 1.24)
Diuretic Titration	1.09	(0.84 – 1.40)	1.06	(0.86 – 1.29)
HF Outpatient Resources	0.81	(0.59 – 1.13)	0.84	(0.65 – 1.09)
HF Specific Causes	0.96	(0.68 – 1.34)	1.03	(0.79 – 1.35)
Discharge Activity Level	1.25	(0.96 – 1.63)	1.23	(1.00 – 1.51)*
ADL Index Score				
Partially Independent	1.43	(0.68 – 2.98)	1.89	(1.07 – 3.33)*

Somewhat Dependent	2.09	(1.20 – 3.65)**	1.92	(1.22 – 3.02)**
Highly Dependent	1.38	(0.58 – 3.29)	1.40	(0.71 – 2.77)
Respiratory Pattern				
Short of Breath at Rest	0.86	(0.56 – 1.34)	1.09	(0.75 – 1.58)
Short of Breath with Activity	0.95	(0.60 – 1.53)	1.22	(0.81 – 1.83)
Medication Non-Adherence	0.97	(0.51 – 1.85)	1.21	(0.69 – 2.09)
Elixhauser Co-Morbidity	1.01	(1.02 – 1.18)*		
Score	1.10	(1.02 – 1.18)**	1.05	(0.98 – 1.12)
Prior HF Admission	2.02	(1.45 – 2.81)**	1.97	(1.48 – 2.62)**
Length of Stay	1.05	(1.00 – 1.10)	1.03	(0.99 – 1.06)
Age	0.99	(0.98 – 1.00)	0.99	(0.98 – 1.00)
Male	1.37	(0.99 – 1.90)	1.19	(0.90 – 1.57)
Race				
Black	1.07	(0.68– 1.70)	0.82	(0.55 – 1.22)
Asian	1.83	(0.57 – 5.89)	1.48	(0.47 – 4.71)
Other	0.30	(0.09 – 2.24)	0.45	(0.14 – 1.40)
Ethnicity				
Hispanic	1.17	(0.62 – 2.18)	1.18	(0.69 – 2.02)
Marital Status				
Single	1.46	(0.98 – 2.18)	1.39	(0.98 – 1.94)
Divorced	1.42	(0.83 – 2.42)	1.33	(0.85 – 2.09)
Patient Lives Alone	1.21	(0.80 – 1.82)	1.20	(0.85 – 1.69)
Health Literacy				
Somewhat / A Little	0.73	(0.35 – 1.53)	1.01	(0.54 – 1.89)
Extreme / Quite a Bit	0.92	(0.44 – 1.90)	1.11	(0.59 – 2.08)
Inpatient Teaching by a Pharmacist	1.56	(0.57 – 4.30)	1.21	(0.50 – 2.91)
Transitional care Post-Discharge	1.00	(0.62 – 1.60)	0.97	(0.69 – 1.37)

The model contains controls for hospital and unit-type effects (not reported in the table).
*$p < .05$, **$p < .01$

Table 4.13 Receiver Operating Characteristic Curve Area Results of the Likelihood of Hospital Readmission and ED Utilization within 30 Days of Discharge and the Dose of Each HF Discharge Specific Teaching Component Model in Selected Patient Populations

Study Populations	IP or Observation Admission within 30 days
All Patients	0.669
Sensitivity Analyses	
Patients without co-morbidity	0.762
Patients discharged home without home care	0.683

Summary

This chapter contained the results of the analyses for all research questions. ROC curves were presented to demonstrate how well the models discriminated patients who did and did not have post-discharge hospital readmission and ED utilization. Two subsets of the study population were used to test the sensitivity of the model.

CHAPTER 5

DISCUSSION

This chapter contains a summary of the overall findings for each research question and discussion of the meaning of the results. Implications for nursing research, education, practice, and vulnerable populations and the health systems that serve them will be reviewed. Strengths and limitations of the study are presented.

Summary of the Findings

This study described the documentation of teaching by nurses during the inpatient stay and the relationship of teaching component dose to heart failure (HF) readmission or Emergency Department (ED) utilization outcomes within 30 days of a previous hospital discharge. Patients were more likely to be readmitted for every unit increase in the documented aggregate teaching component dose and with every unit increase in the activity level component dose. Patients were less likely to be readmitted with each additional documented exposure to the sodium restriction component.

Patients were more likely to experience an ED visit within 30 days with each additional documented dose of the fluid restriction component and less likely to have an ED visit with each additional documented dose of the diuretic titration component. Discharge teaching was most effective when key information was repeated at least once. No association was found between the number of components received and hospital

readmission or ED utilization. Patient characteristic and clinical condition factors did not moderate the relationship between discharge teaching and outcomes.

Research Question 1

The first question in this study examined the relationship between the aggregate component dose of discharge teaching documented in the hospital and HF readmission or ED utilization within 30 days of hospital discharge after controlling for patient characteristics, clinical condition factors, inpatient pharmacy teaching, and transitional care. In this analysis, patients' likelihood of readmission increased 2% with each additional unit of discharge teaching documented. This finding is somewhat consistent with previous research which found compliance to the HF-1 core measure component completion (rather than component dose) was associated with an increased risk for readmission within one year (HR = 1.04) (CMS, 2015).

Comparable to other studies, patients in this population who had experienced a prior hospitalization were at greater risk for readmission (Borenstein et al., 2013; Gruneir et al., 2011; Hummel et al., 2014) or ED utilization (Brennan, Chan, Killeen, & Castillo, 2015; Steiner, Barrett, & Hunter, 2010). Nurses may have increased overall teaching frequency in an effort to explain care provided in the hospital and reinforced information necessary for self-care for patients with persistent symptoms of HF at time of discharge. Patients may have been more aware of worsening symptoms and the need to seek care in the 30 day post-discharge period.

No relationship was found between the documented aggregate component dose and ED utilization post-discharge. This finding is partially consistent with the work of Weiss, Yakusheva, and Bobay (2011) who found the dose of teaching content received over the course of the hospital stay was weakly associated with discharge readiness, which then was associated with ED utilization post-discharge. The dose of content in their study was indirectly associated with ED visits.

Relationships between readmission and ED utilization outcomes and patient characteristic and clinical condition factors were identified. While most studies have identified age greater than 65 as a predictor of readmission (Kansagara, Englander, Salanitro, & et al., 2011; Ross et al., 2008), in this study there was a weak relationship between each additional year of age greater than 66.6 and a decreased likelihood of hospital readmission or ED utilization. To identify the age range most associated with readmission and ED utilization, age was categorized into four quartile ranges. Twenty-eight percent of patients readmitted to the hospital and 33% of patients who experienced an ED visit post-discharge were between the ages of 18 to 57. This younger age group may have been recently diagnosed and therefore at higher risk of recurrent hospitalizations (Chun et al., 2012).

A longer length of stay during the previous hospitalization was another factor significantly associated with inpatient readmission. The average length of stay for patients in this sample was 5.3 days with a SD of 4.6 days. A longer than average length of stay has been associated with a greater risk of decreased functional capacity that can continue after discharge (Borenstein et al., 2013; Fisher et al., 2013) and patients in this analysis who were either partially dependent or somewhat independent in their ability to

complete their activities of daily living (including bathing, dressing, toileting, transferring, continence, and feeding) were more likely to be readmitted. Nursing interventions to sustain or maintain functional capacity would be important for these patients. Patients highly dependent on others to assist with activities of daily living were not at greater risk, possibly due to better support structures in place at home.

The patient population in this study differed from previous HF studies which have identified male patients at increased risk for readmission (Amarasingham et al., 2010; Gheorghiade et al., 2013). Similar to a study of 11,642 HF patients conducted by Frazier et al. (2007), male patients in this sample were no more at risk for readmission than female patients. The incidence of readmission of married HF patients was not significantly different from single or divorced patients in the all patients group. Although patient race has been identified at greater risk for readmission (Joynt et al., 2011; Vivo et al., 2014), no significant relationships were found between racial or ethnic groups and post-discharge outcomes in this study.

The presence of HF symptoms which persist at discharge has been demonstrated to increase the odds of readmission (DeVore et al., 2014). Although 49% of patients in this study reported shortness of breath at rest and 28% of patients reported shortness of breath with activity at their last recorded respiratory assessment, no significant associations between respiratory pattern and readmission or ED utilization were found.

Medication non-adherence was not significantly associated with readmission or ED utilization in the all-patient model. Ninety-two % of patients reported taking medications as prescribed. This reported adherence rate is much higher than reported

elsewhere and patients could have been providing a socially acceptable answer to the question of whether they had or had not been taking their medications as prescribed (Fitzgerald et al., 2011).

Research Question 2

Research question 2 examined the statistical interactions between patient characteristic or clinical condition factors and the aggregate teaching component dose and how those interactions may have affected hospital readmission or ED utilization. Interaction variables were created for the prior HF admission, health literacy, and Elixhauser co-morbidity score variables and the aggregate component dose of HF discharge teaching based upon significant associations between these variables and the aggregate component dose in univariate analysis. No statistical interactions were found which would have supported a moderating effect for any of the variables. Nurses could have been providing teaching per protocol and may not have adjusted teaching to whether the patient had received the teaching before or to the patient's severity of illness or health literacy.

Research Question 3

Research question 3 examined the association between the doses of each discharge-specific teaching component of the HF education plan and readmission or ED utilization post discharge. These seven teaching components were analyzed together in the inpatient readmission and ED utilization regression models because the healthcare system had selected them as essential discharge teaching, consistent with regulatory and

national HF guidelines. In the hospital readmission model, the pattern of nursing documentation was consistent with the findings of Albert and colleagues (2015) who examined nurse report of HF component teaching and found weight monitoring education documented in high frequency. Weight monitoring is an assessment strategy used to identify worsening HF and further action would have been needed to reduce the risk of readmission or ED visits post-discharge.

No associations were found between the HF discharge-specific teaching component dose and ED utilization. The lack of significance can be attributed to methodological issues related to multicollinearity between the discharge-specific teaching components. Discharge-specific teaching components overlapped in function with each other and the remaining components within the fluid volume excess education plan and fewer component options with unique functions would have provided a more precise analysis. When highly correlated variables were removed in the all teaching component dose analyses, it became apparent the significance of the discharge activity level component had been suppressed. Similarly, when the discharge diet / fluid intake component was removed in the all teaching component dose analyses, the more specific sodium restriction and fluid restriction components achieved significance in the inpatient readmission model and the ED utilization model respectively.

Research Question 4

To answer research question 4, the teaching component count was entered into the logistic regression model to determine if the number of components documented as completed during the entire index hospitalization was associated with a lower risk of

hospital readmission or ED utilization. The findings in this study were consistent with previous research which found no significant dose-response association between HF teaching component completion and hospital readmission within 30 days of discharge after controlling for covariates (Jensen, 2011; VanSuch et al., 2006).

The teaching components most frequently included in the patient teaching plan were the HF fluid volume excess, the HF fluid volume excess treatment, and the HF symptom monitoring components. Nurses would likely have included this instruction to explain the connection between the patients' symptoms to their HF treatment while in the hospital. Patients were less likely to receive education on diuretic titration, outpatient resources, and overcoming barriers, suggesting the content selected was knowledge/skill based and not self-management focused.

Research Question 5

The last research question examined the relationship between each teaching component dose and readmission or ED utilization post-discharge. The examination of the relationship between the dose of each teaching component and readmission and ED utilization post-discharge was a methodological improvement over previous research which examined HF core measure component completion only. Nurses selected from all 15 of the hospital teaching components offered in the HF fluid volume excess education plan. However, seven of the teaching components were highly correlated, suggesting these predictors were performing the same function. Eight teaching components were retained in the simplified teaching component dose model.

Patients who received increased activity level teaching were more likely to experience a hospital readmission. The majority of patients in this sample experienced shortness of breath at rest and with activity at time of discharge. Also, patients who were partially independent or somewhat dependent were more likely to be readmitted. Nurses may have recognized the need for repeated activity level teaching for these patients.

Sodium restriction teaching was provided to 81.5% of patients at least once during the index hospitalization (m = 1.73, range = 0-21). Each additional dose of sodium restriction teaching was associated with a decreased risk of readmission. Adherence to a cardiac diet can be difficult for the HF patient and diet and fluid recommendations may vary based on the severity of the patient's symptoms (Blair et al., 2014; Riegel et al., 2009). Patients may report they are following their diet but, upon further investigation, are using packaged food either because they are unaware of the sodium content or they have limited access to fresh foods (Colin-Ramirez, McAlister, Woo, Wong, & Ezekowitz, 2014; Stevenson, Pori, Payne, Black, & Taylor, 2015). In this group of HF patients, a single exposure to teaching was not as effective as repeated exposure to the sodium restriction component. This finding supports national guidelines and standards which advise breaking down teaching into segments, providing education in limited amounts throughout the hospital stay, and repeating key information (AHRQ, June 2013; Heart Failure Society of America, 2010b; Jessup et al., 2009; Nielsen et al., 2008).

The odds of experiencing an ED visit increased with each additional dose of fluid restriction teaching. There were a large number of patients with co-morbid renal failure in this sample (N = 769) who may have needed the fluid restriction component. Nurses may

have focused their education on fluid restriction when patients were in acute exacerbation of their HF and repeated teaching for patients with co-morbid renal disease or lingering symptoms of fluid volume excess at time of discharge. Although this was not measured in this study, a dietary consult during the inpatient stay and follow-up post discharge might have benefited patients who required these significant dietary modifications.

A significant association was found between each additional dose of documented diuretic titration teaching and a lower likelihood of ED utilization. Teaching focused on establishing an action plan to fully prepare patients to initiate changes to their diet, fluid intake, or diuretics may have mitigated the risk of ED utilization. Overall, the c-statistics or area under the curve results of the component dose models indicate they were able to predict 69.2% of the inpatient readmission events and 72.1% of the ED utilization events.

Additional Analysis

Sensitivity analyses were conducted to evaluate model performance when applied to subsets of the full population. Patients without the fluid and electrolyte imbalance co-morbidity were selected because they did not have what is considered a complication of care. The model remained stable with regard to the significant teaching component variables. Model discrimination improved when this subset was compared to the performance of the full population model.

The second sensitivity analysis was conducted to compare patients discharged to home without home care to the full population. The sodium restriction and activity level teaching components lost significance in this analysis. Clinical condition factors may have been more impactful in predicting readmission in this subset. The patients

discharged to home without home care were more likely to be readmitted if they had more co-morbid conditions than the population average. The patients discharged home without home care model discriminated slightly better (c statistic 0.683) than the full population model.

Strengths and Limitations

This retrospective correlational study utilized nursing data extracted from the EHR rather than nurse or patient report, which might over or underestimate teaching frequency or component selection (Albert et al., 2014), to describe the relationship between the dose and type of teaching interventions provided to the patient. An effectiveness research framework, the Model for Effectiveness Research, guided variable selection. A standardized nursing language employed throughout the healthcare system's EHR allowed for the association of teaching component dose to readmission and ED utilization, extending previous research which utilized nursing documentation to associate processes of care to outcomes (Titler, et al., 2011).

To ensure a more precise relationship to HF discharge teaching, the outcome variable was limited to the occurrence of HF specific readmission or ED visits rather than all cause readmissions or ED visits unrelated to the previous HF hospitalization. The addition of ROC curve and sensitivity analyses further explained model discrimination and performance. Lastly, the study population was diverse in age, race, and ethnicity

This study design had limitations. The outcome of hospital readmission may have been underestimated, as patients might have been readmitted to other hospitals outside of the healthcare system. Additionally, the data was limited to billing and encounter data in

the healthcare system's EHR and the presence of all co-morbid conditions may not have been documented for each patient. Replication of the study may also be impeded by the ability to find similar discrete fields for the independent and control variables within another healthcare organization EHR due to a lack of standardized language use in nursing documentation (Delaney, Pruinelli, Alexander, & Westra, 2016; Maas & Delaney, 2004).

This study described the association between teaching component dose and readmission and no other aspects of discharge teaching. Nurses may have had varying levels of proficiency in performing learning assessments, knowledge related to HF content, and skill in delivering patient education which might have affected teaching delivery and discharge outcomes. Since nurses other than those assigned to the unit utilized the same HF teaching plan to document their discharge teaching, nurses other than those assigned to the unit may have provided instruction. In some instances, the patient may have received HF discharge teaching from a dietician, an advanced practice nurse, a physician, a physician assistant, or a clinic nurse and this was not captured. Additionally, nurses and providers may not have documented all of the discharge teaching they provided during the index hospitalization. Additional transitional care other than care provided by a home care nurse or outreach by a transition coordinator may have occurred after discharge and this was not measured.

Methodological issues existed as well. The HF fluid volume excess treatment plan had multiple overlapping components which resulted in multicollinearity. Reducing the number of components to an abbreviated group of variables eliminated the collinearity problem statistically but it may not have corrected for the possibility that

nurses might have, for some reason, chosen to document on one similar component versus another component then eliminated in the analysis. The models also had many control variables and a more simplified model might have performed just as well.

Implications for Research

This study contributes to previous research describing the concept of nurse dose and its relationship to outcomes. Nurse dose has been conceptualized in several ways to measure the effectiveness of nursing care. In a patient level study of the effect of the dose of BSN preparation on outcomes, patients who had received > 80% of their care by a BSN prepared nurse demonstrated 18.7% lower odds of readmission and a 1.9% shorter length of stay (Yakusheva et al., 2014a).

Manojlovich, Sidani, Covell, & Antonakos (2011) conceptualized nurse dose to consist of an active ingredient (education, experience, and skill mix) and intensity (full-time employees, RN: patient ratio, RN hours per patient day). An increase in nurse dose had a strong inverse association to the outcomes of MRSA infection and falls. From an economic perspective, nurse value added was conceptualized as the dose of nurse educational preparation and expertise and was positively associated with shorter lengths of stay and lower costs (Yakusheva, Lindrooth, & Weiss, 2014b). These studies demonstrate nursing care and attributes can be measured in terms of dose and there is a dose-response relationship to patient outcomes.

Previous studies have linked nursing structure to patient outcomes. This study adds to the body of evidence supporting the impact of nursing care processes on patient outcomes as conceptualized in the Model for Effectiveness Research. The dose of

discharge teaching was directly linked to hospital readmission and ED utilization within 30 days of discharge. This exploratory model should be further tested and validated.

Future research is needed to improve measurement of intervention dose and evaluate how the dose of interventions such as discharge teaching contributes to quality patient care. This study provided evidence to support that repeated teaching makes a difference, even in short lengths of stay. Since not all nurses have the same educational preparation, the effect of nursing attributes on discharge education quality would be another consideration in the study of nurse dose. The effect of nursing attributes on the dose and quality of discharge teaching would provide insight into how well nurses are prepared to teach self-management skills. Future study of the discharge teaching process would provide important information to inform how to design effective educational assessment and teaching strategies and integrate them into nursing workflow and the workflow of the discharge process.

Implications for Nursing Education

Patient teaching is recognized as a fundamental skill essential to nursing practice. The Scope and Standards of Nursing Practice includes competencies related to health teaching and health promotion (American Nurses Association, 2010). The American Association of Colleges of Nursing (AACN, 2008) Essentials of Baccalaureate Education for Professional Nursing Practice identifies nurses must be prepared to provide appropriate teaching considering developmental stage, age, patient preferences, and health literacy to engage patients in their self-care management.

In the HF population, self-care maintenance is the adherence to recommendations to take medications as prescribed, eat a low sodium diet, exercise, monitor for weight gain, recognize worsening of symptoms, and knowing when to seek follow up (Riegel et al., 2009). Inpatient nurses play an important role as educators in the acute care setting, ensuring HF patients have the necessary knowledge to manage their HF post-discharge (Riegel et al., 2009; Weiss et al., 2015). Programs established to improve the transition to home all include education as an important component (Coleman et al., 2006; Hansen et al., 2013; Jack et al., 2009; Nielsen et al., 2008). As the Essentials of Baccalaureate Nursing Education describes, undergraduate nursing programs integrate education on patient teaching into coursework. Students could benefit from intentional and concentrated education on health literacy assessment, patient education, and knowledge evaluation strategies, which could be practiced during clinical and/or simulation experiences (Fidyk, Ventura, & Green, 2014).

A precursor to quality patient education is an assessment of the patient's level of health literacy and barriers to learning which may impede understanding (Coleman et al., 2013; Regalbuto et al., 2014). As this study demonstrated, patient educational needs assessments were not consistently documented. Given the importance of health literacy as mediator of information exchange between the patient and the nurse (Edwards et al., 2009), a needs assessment should be performed to evaluate nurses' proficiency in evaluating health literacy and other barriers to learning such as language barriers and cognitive impairment. Continuing education could be offered to nurses who may be novice educators or have not had educational preparation in adult learning theory and teaching strategies which accommodate the patient's capacity to learn such as chunking

of information into meaningful segments, reflection and repeated exposure to key concepts, and teach-back techniques (Bransford & Cocking, 2000). Competency assessments could be designed to assess nurse knowledge of content and proficiency in delivering patient education during orientation or as a part of an annual practice evaluation.

Implications for Vulnerable Patients and Health Systems Serving Vulnerable Populations

Previous studies have found no association between compliance to prescribed HF educational content completion and a decrease in hospital readmission (CMS, 2015; Jensen, 2011). Rather than teaching per protocol, patients might benefit from HF self-management teaching content that is individualized based on the patient's perceived barriers and level of knowledge (Heart Failure Society of America, 2010b; Yancy, et al., 2013). Patients admitted with exacerbation of their heart failure may have limited capacity for lengthy teaching sessions and adherence to an action oriented treatment plan can be hampered by the patient's lack of understanding of their discharge instructions (Zavala & Shaffer, 2011). The frequency of nursing documentation in this study suggests teaching was integrated into the nurse's daily workflow rather than provided one time on day of discharge and demonstrates that positive outcomes can be achieved with frequent teaching exposure throughout the hospital stay.

Patients who understand their self-management treatment plan and recognize and react to worsening symptoms have an associated reduction in readmission and ED visits post-discharge (Kommuri, Johnson, and Koelling, 2012; Lee, Moser, Lennie, & Riegel, 2011; Wang, et al., 2014). To achieve desired outcomes, exposure to HF teaching

components must be hardwired into the care delivery model and delivered in a dose appropriate to the needs of each patient. Nurse executives and managers are critical to ensuring the resources necessary for the delivery of quality education (Weiss et al., 2011).

Implications for Nursing Practice

Adults learn best when presented with their own unique problems (Burkhart, 2008). Nurses must be able to determine what the patient understands and what they need to do and focus their limited teaching time on those action strategies. Patients who received an increased dose of sodium restriction education were less likely to experience a readmission. It is important for nurses to provide teaching and stress the benefits of reducing sodium intake if patients are to achieve long term adherence (Chung, et al., 2017; Wu et al., 2017).

Patients who received an increased dose of diuretic titration teaching were less likely to experience an ED visit post-discharge. These findings validate the importance of self-management focused teaching content and supports national guidelines and standards which advise breaking down teaching into segments, providing education in limited amounts throughout the hospital stay, and repeating key information (AHRQ, June 2013; Heart Failure Society of America, 2010b; Jessup et al., 2009; Nielsen, 2008). The evidence supporting diuretic titration programs has not been strong (Piano, Prasun, Stamos, & Groo, 2011), but diuretic titration training has been demonstrated to be effective in improving ED visit and readmission outcomes in select patients who could adhere to daily weight monitoring and perform weight based diuretic instruction (Jones et

al., 2012). Since this strategy requires close follow-up post-discharge, patients might benefit from the support of a telehealth monitoring program or other transitional care programs (Bashi, Karunanithi, Fatehi, Ding, & Walters, 2017; Naylor et al., 2013).

Conclusion

The findings of this study produced conflicting information about the relationship between heart failure discharge teaching and post-discharge utilization of readmission and ED visits. Patients with more documented teaching overall or who had increased exposure to the activity level and fluid restriction components of the fluid volume excess education plan were more likely to be readmitted or experience an ED visit post discharge. Two teaching components were significantly related to a decreased likelihood of post-discharge utilization. Increased exposure to the sodium restriction teaching component decreased the likelihood of readmission and increased exposure to the diuretic titration teaching component decreased the likelihood of ED utilization, demonstrating the importance of repeating teaching content that is self-management focused. This research adds to the study of nurse dose by utilizing nursing documentation from the EHR to link the nursing care process of discharge teaching to the outcomes of hospital readmission and ED utilization within 30 days of discharge. Further research is needed to clarify the relationship between the type and dose of HF teaching and patient outcomes.

BIBLIOGRAPHY

AACN. (2008). Essentials of baccalaureate education for professional nursing practice. http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf

Adams, K. F., Lindenfeld, J., Arnold, J. M. O., Barnard, D. H., Baughman, K. L., Boehmer, J. P., . . . Wagoner, L. E. (2006). Comprehensive heart failure guideline. *Journal of Cardiac Failure, 12*, e1-e122.

AHRQ, (2011). HCUP Comorbidity Software (3.6). Rockville, MD: Healthcare cost and utilization project (HCUP). from www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp

Agency for Health Care Policy and Research. (1994). *Heart failure: management of patients with left-ventricular systolic dysfunction: quick reference guideline* Rockville, MD: Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK52136/.

AHRQ. (June 2013). Strategy 4: care transitions from hospital to home: IDEAL discharge planning. from http://www.ahrq.gov/professionals/systems/hospital/engagingfamilies/strategy4/index.html

Aiken, L. H., Cimiotti, J., Sloane, D. M., Smith, H., & Neff, D. F. (2011). Effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environment. *Medical Care, 49*(12), 1047-1053.

Aiken, L. H., Clarke, S. P., Cheung, R. B., Sloane, D. M., & Silber, J. H. (2003). Educational levels of hospital nurses and surgical patient mortality. *The Journal of the American Medical Association, 290*(12), 1617-1623.

Albert, N. M., Aspinwall, L., Liu, X., Pratt, L., Best, C. H., & Cohen, B. (2011). Heart failure hospital nurses need help (health education and logical planning) to educate patients. *Heart & Lung: The Journal of Acute and Critical Care, 40*(4), 363. doi: http://dx.doi.org/10.1016/j.hrtlng.2011.04.006

Albert, N. M., Cohen, B., Liu, X., Best, C. H., Aspinwall, L., & Pratt, L. (2015). Hospital nurses' comfort in and frequency of delivering heart failure self-care education. *European Journal of Cardiovascular Nursing, 14*(5), 431-440.

Allen, L. A., Smoyer Tomic, K. E., Smith, D. M., Wilson, K. L., & Agodoa, I. (2012). Rates and predictors of 30-day readmission among commercially insured and Medicaid-enrolled patients hospitalized with systolic heart failure. *Circulation Heart Failure, 5*, 672-679. doi: 10.1161/CIRCHEARTFAILURE.112.967356

Amarasingham, R., Moore, B. J., Tabak, Y., Drazner, M. H., Clark, C. A., Zhang, S., . . . Halm, E. (2010). An automated model to identify heart failure patients at risk for 30-day readmission or death using electronic medical record data. *Medical Care, 48*(11), 981-988.

American College of Cardiology. (2017). About ACC. Retrieved from http://www.acc.org/about-acc

American College of Cardiology. (2016). Hospital to Home. Retrieved January 13, 2016, from http://cvquality.acc.org/Initiatives/H2H/Getting-Started.aspx

American Heart Association. (2017). About the American Heart Association. Retrieved from http://www.heart.org/HEARTORG/General/About-Us---American-Heart-Association_UCM_305422_SubHomePage.jsp?_ga=1.82902165.2011793574.1491574555

American Nurses Association. (2010). *Nursing scope and standards of practice* (2nd ed.). Silver Spring, MD: Nursesbooks.org.

Anderson, K.M. (2013). Discharge clinical characteristics and 60-day readmission in patients hospitalized with heart failure. *Journal of Cardiovascular Nursing, 29*(3), 232-241.

Au, A. G., McAlister, F. A., Bakal, J. A., Ezekowitz, J., Kaul, P., & Van Walraven, C. (2012). Predicting the risk of unplanned readmission or death within 30 days of discharge after a heart failure hospitalization. *American Heart Journal, 164*(3), 365-372.

Austin, S. R., Wong, Y., Uzzo, R. G., Beck, J. R., & Egleston, B. L. (2013). Why summary comorbidity measures such as the Charlson Comorbidity Index and Elixhauser Score work. *Medical Care*, 1-18. doi: 10.1097/MLR.0b013e318297429c

Barnes, D. E., Mehta, K. M., Boscardin, W. J., Fortinsky, R. H., Palmer, R. M., Kirby, K. A., & Landefeld, C. S. (2013). Prediction of recovery, dependence or death in elders who become disabled during hospitalization. *Journal of General Internal Medicine, 28*(2), 261-268. doi: 10.1007/s11606-012-2226-y

Bashi, N., Karunanithi, M., Fatehi, F., Ding, H., & Walters, D. (2017). Remote monitoring of patients with heart failure: an overview of systematic reviews. *Journal of Medical Internet Research, 19*(1), e18. doi: 10.2196/jmir.6571

Benjamin, E. J., Blaha, M.J., Chiuve, S.E., Cushman, M., Das, S.R., Deo, R., …Muntner, P. (2017). Heart disease and stroke statistics—2017 update: a report from the American Heart Association. *Circulation, 135*, e146-e603. doi:DOI: 10.1161/CIR.0000000000000485

Bergh, A. L., Friberg, F., Persson, E., & Dahlborg-Lyckhage, E. (2014). Perpetuating 'new public management' at the expense of nurses' patient education: a discourse analysis. *Nursing Inquiry*, 1-12. doi: 10.1111/nin.12085

Berkman, N., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: an updated systematic review. *Annals of Internal Medicine, 155*(2), 97.

Blair, J., Volpe, M., & Aggarwal, B. (2014). Challenges, needs, and experiences of recently hospitalized cardiac patients and their informal caregivers. *Journal of Cardiovascular Nursing, 29*(1), 29-37.

Bobay, K. L., Jerofke, T. A., Weiss, M. E., & Yakusheva, O. (2010). Age-related differences in perception of quality of discharge teaching and readiness for hospital discharge. *Geriatric Nursing, 31*(3), 178.

Borenstein, J., Aronow, H., Bolton, L., Choi, J., Bresee, C., & Braunstein, G. (2013). Early recognition of risk factors for adverse outcomes during hospitalization among Medicare patients: a prospective cohort study. *BMC Geriatrics, 13*(1), 72.

Bransford, J. D., & Cocking, R. R. (2000). *How people learn*. Washington, D.C.: National Academy Press.

Brennan, J. J., Chan, T. C., Killeen, J. P., & Castillo, E. M. (2015). Inpatient readmissions and emergency department visits within 30 days of a hospital admission. *Western Journal of Emergency Medicine, 16*(7), 1025-1029. doi: 10.5811/westjem.2015.8.26157

Brooks-Carthon, J. M., Lasater, K. B., Sloane, D. M., & Kutney-Lee, A. (2015). The quality of hospital work environments and missed nursing care is linked to heart failure readmissions: a cross-sectional study of US hospitals. *British Medical Journal Quality & Safety, 0*, 1-9. doi: 10.1136/bmjqs-2014-003346

Brown, C. J., Friedkin, R. J., & Inouye, S. K. (2004). Prevalence and outcomes of low mobility in hospitalized older patients. *Journal of the American Geriatrics Society, 52*(8), 1263-1270. doi: 10.1111/j.1532-5415.2004.52354.x

Burkhart, J. A. (2008). Training nurses to be teachers. *Journal of Continuing Education in Nursing, 39*(11), 503-510. doi: 10.3928/00220124-20081101-02

Capuano, T., Bokovoy, J., Hitchings, K., & Houser, J. (2005). Use of a validated model to evaluate the impact of the work environment on outcomes at a Magnet hospital. *Health Care Management Review, 30*(3), 229-236.

Centers for Medicare and Medicaid Services. (2012). Readmissions reduction program. Retrieved 1/6/14, from http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html

Centers for Medicare and Medicaid Services. (2015). Hospital Compare. Retrieved January 7, 2014, from http://www.medicare.gov/hospitalcompare/search.html

Chang, P. P., Chambless, L. E., Shahar, E., Bertoni, A. G., Russell, S. D., Ni, H., . . . Rosamond, W. D. (2014). Incidence and survival of hospitalized acute decompensated heart failure in four US communities (from the Atherosclorosis Risk in Communities Study). *American Journal of Cardiology, 113*, 504-510.

Chew, L. D., Bradley, K. A., & Boyko, E. J. (2004). Brief questions to identify patients with inadequate health literacy. *Family Medicine, 36*(8), 588-594.

Chun, S., Tu, J., Wijeysundera, H. C., Austin, P. C., Wang, X., Levy, D., & Lee, D. (2012). Lifetime analysis of hospitalizations and survival of patients newly admitted with heart failure. *Circulation: Heart Failure, 5*(4), 414-421. doi: 10.1161/CIRCHEARTFAILURE.111.964791

Chung, M. L., Lennie, T. A., Riegel, B., Wu, J., Dekker, R. L., & Moser, D. K. (2009). Marital status as an independent predictor of event-free survival of patients with heart failure. *American Journal of Critical Care, 18*(6), 562-570. doi: 10.4037/ajcc2009388

Chung, M.L., Park, L., Frazier, S.K., & Lennie, T.A. (2017). Long-term adherence to low sodium diet in patients with heart failure. *Western Journal of Nursing Research,* 39(*4),* 553-567. doi: 10.1177/0193945916681003

CMS. (2015). 2015 national impact assessment of the Centers for Medicare & Medicaid services (CMS) quality measures report. Baltimore, Maryland.

Coleman, E., Parry, C., Chalmers, S., & Sung-joon, M. (2006). The care transitions intervention: results of a randomized controlled trial. *Archives of Internal Medicine, 166,* 1822-1828.

Coleman, E. A., Chugh, A., Williams, M. V., Grigsby, J., Glasheen, J. J., McKenzie, M., & Min, S. J. (2013). Understanding and Execution of Discharge Instructions. *American Journal of Medical Quality, 28*(5), 383-391.

Colin-Ramirez, E., McAlister, F. A., Woo, E., Wong, N., & Ezekowitz, J. A. (2014). Association Between Self-reported Adherence to a Low-Sodium Diet and Dietary Habits Related to Sodium Intake in Heart Failure Patients. *J Cardiovasc Nurs*. doi: 10.1097/jcn.0000000000000124

Cook, L., Castrogiovanni, A., David, D., Stephenson, D. W., Dickson, M., Smith, D., & Bonney, A. (2008). Patient education documentation: is it being done? *MEDSURG Nursing, 17*(5), 306-310.

Coster, S., & Norman, I. (2009). Cochrane reviews of educational and self-management interventions to guide nursing practice: a review. *International Journal of Nursing Studies, 46*(4), 508-528. doi: http://dx.doi.org/10.1016/j.ijnurstu.2008.09.009

Curtis, J., Schreiner, G., Wang, Y., Chen, J., Spertus, J., Rumsfeld, J., . . . Krumholz, H. (2009). All-cause readmission and repeat revascularization after percutaneous

coronary intervention in a cohort of Medicare patients. *Journal of the American College of Cardiology, 54*(10), 903 - 907.

Delaney, C. W., Pruinelli, L., Alexander, S., & Westra, B. L. (2016). 2016 nursing knowledge big data science initiative. *Computers, Informatics, Nursing, 34*(9), 384-386.

Dennison, C. R., McEntee, M. L., Samuel, L., Johnson, B. J., Rotman, S., Kielty, A., & Russell, S. D. (2011). Adequate health literacy is associated with higher heart failure knowledge and self-care confidence in hospitalized patients. *Journal of Cardiovascular Nursing, 26*(5), 359-367 310.1097/JCN.1090b1013e3181f1016f1088.

DePalma, G., Xu, H., Covinsky, K. E., Craig, B. A., Stallard, E., Thomas, J., & Sands, L. P. (2013). Hospital readmission among older adults who return home with unmet need for ADL disability. *The Gerontologist, 53*(3), 454-461. doi: 10.1093/geront/gns103

Deswal, A., Petersen, N. J., Souchek, J., Ashton, C. M., & Wray, N. P. (2004). Impact of race on health care utilization and outcomes in veterans with congestive heart failure. *Journal of the American College of Cardiology, 43*(5), 778-784. doi: http://dx.doi.org/10.1016/j.jacc.2003.10.033

DeVore, A. D., Hammill, B. G., Sharma, P. P., Qualls, L. G., Mentz, R. J., Waltman Johnson, K., . . . Hernandez, A. F. (2014). In-hospital worsening heart failure and associations with mortality, readmission, and healthcare utilization. *Journal of the American Heart Association, 3*(4). doi: 10.1161/jaha.114.001088

Dickson, V. V., Tkacs, N., & Riegel, B. (2007). Cognitive influences on self-care decision making in persons with heart failure. *American Heart Journal, 154*(3), 424-431.

DiMatteo, M. R., Lepper, H. S., & Croghan, T. W. (2000). Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. *Archives of Internal Medicine, 160*(14), 2101-2107.

Dodson, J. A., Truong, T. N., Towle, V. R., Kerins, G., & Chaudhry, S. I. (2013). Cognitive impairment in older adults with heart failure: prevalence, documentation, and impact on outcomes. *The American Journal of Medicine, 126*(2), 120-126. doi: http://dx.doi.org/10.1016/j.amjmed.2012.05.029

Edwards, M., Davies, M., & Edwards, A. (2009). What are the external influences on information exchange and shared decision-making in healthcare consultations: a meta-synthesis of the literature. *Patient Education and Counseling, 75*, 37-52.

Elixhauser, A., Steiner, C., Harris, D., & Coffey, R. (1998). Comorbidity measures for use with administrative data. *Medical Care, 36*(1), 8 - 27.

Escobar, G. J., Ragins, A., Scheirer, P., Liu, V., Robles, J., & Kipnis, P. (2015). Nonelective rehospitalizations and postdischarge mortality. *Medical Care, 53*(11), 916-923.

Estabrooks, C. A., Midodzi, W. K., Cummings, G. G., Ricker, K. L., & Giovannetti, P. (2005). The impact of hospital nursing characteristics on 30-day mortality. *Nursing Research, 54*(2), 74-84.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statitical power analysis using G Power 3.1: tests for correlation and regression analyses. *Behavioral Research Methods, 41*(4), 1149-1160. doi: doi:10.3758/BRM.41.4.1149

Federal Register (2014). *Hospital inpatient prospective payment systems for acute care hospitals and the long-term care hospital prospective payment system and fiscal year 2015 rates*. (79(*163*):49853–50536).

Federman, A. D., Sano, M., Wolf, M. S., Siu, A. L., & Halm, E. A. (2009). Health literacy and cognitive performance in older adults. *Journal of the American Geriatrics Society, 57*(8), 1475-1480. doi: 10.1111/j.1532-5415.2009.02347.x

Fidyk, L., Ventura, K., & Green, K. (2014). Teaching nurses how to teach: Strategies to enhance the quality of patient education. *Journal for Nurses in Professional Development, 30*(5), 248-253.

Fisher, S. R., Kuo, Y. F., Sharma, G., Raji, M. A., Kumar, A., Goodwin, J. S., . . . Ottenbacher, K. J. (2013). Mobility after hospital discharge as a marker for 30-day readmission. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 68*(7), 805-810. doi: 10.1093/gerona/gls252

Fitzgerald, A. A., Powers, J. D., Ho, P. M., Maddox, T. M., Peterson, P. N., Allen, L. A., . . . Havranek, E. P. (2011). Impact of medication nonadherence on hospitalizations and mortality in heart failure. *Journal of Cardiac Failure, 17*(8), 664-669. doi: 10.1016/j.cardfail.2011.04.011

Fonarow, G. C., Abraham, W. T., Albert, N. M., Stough, W. G., Gheorghiade, M., Greenberg, G. H., . . . Young, J. B. (2008). Factors identified as precipitating hospital admissions for heart failure and clinical outcomes: findings from OPTIMIZE-HF. *Archives of Internal Medicine, 168*(8), 847-834.

Foraker, R. E., Rose, K. M., Suchindran, C. M., Chang, P. P., McNeill, A. M., & Rosamond, W. D. (2011). Socioeconomic status, Medicaid coverage, clinical comorbidity, and rehospitalization or death after an incident heart failure hospitalization: atherosclerosis risk in communities cohort (1987 to 2004). *Circulation: Heart Failure, 4*(3), 308-316. doi: 10.1161/circheartfailure.110.959031

Frank-Bader, M., Beltran, K., & Dojlidko, D. (2011). Improving transplant discharge education using a structured teaching approach. *Progress in Transplantation, 21*(4), 332-339.

Frazier, C. G., Alexander, K. P., Newby, L. K., Anderson, S., Iverson, E., Packer, M., . . . Douglas, P. S. (2007). Associations of gender and etiology with outcomes in heart failure with systolic dysfunction: a pooled analysis of 5 randomized control trials. *Journal of the American College of Cardiology, 49*(13), 1450-1458. doi: http://dx.doi.org/10.1016/j.jacc.2006.11.041

French, D., Bass, E., Bradham, D., Campbell, R., & Rubenstein, L. (2008). Rehospitalization after hip fracture: predictors and prognosis from a national veterans study. *Journal of the American Geriatrics Society, 56*(4), 705-710.

Friedman, B., Jiang, H. J., & Elixhauser, A. (2008). Costly hospital readmissions and complex chronic illness. *Inquiry, 45*, 408-421.

Gazmararian, J. A., Williams, M. V., Peel, J., & Baker, D. W. (2003). Health literacy and knowledge of chronic disease. *Patient Education and Counseling, 51*(3), 267-275. doi: http://dx.doi.org/10.1016/S0738-3991(02)00239-2

Gharacholou, S. M., Hellkamp, A. S., Hernandez, A. F., Peterson, E. D., Bhatt, D. L., Yancy, C. W., & Fonarow, G. C. (2011). Use and predictors of heart failure disease management referral in patients hospitalized with heart failure: insights from the get with the guidelines program. *Journal of Cardiac Failure, 17*(5), 431-439.

Gheorghiade, M., Vaduganathan, M., Fonarow, G. C., & Bonow, R. O. (2013). Rehospitalization for heart failure: problems and perspectives. *Journal of the American College of Cardiology (JACC), 61*(4), 391-403. doi: 10.1016/j.jacc.2012.09.038

Gilmore, V. I., Efird, L., Fu, D., Leblanc, Y., Nesbit, T., & Swarthout, M. (2015). Implementation of transitions-of-care services through acute care and outpatient pharmacy collaboration. *American Journal of Health-System Pharmacy, 72*(9), 737-744. doi: 10.2146/ajhp140504

Giuliano, K. K., Danesh, V., & Funk, M. (2016). The relationship between nurse staffing and 30-day readmission for adults with heart failure. *Journal of Nursing Administration, 46*(1), 25-29.

Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Borden, W. B., . . . Howard, V. J. (2013). Heart disease and stroke statistics - 2013 update: A report from the American Heart Association. *Circulation, 127*, e6-e245. doi: 10.1161/CIR.0b013e31828124ad

Gruneir, A., Dhalla, I., Walraven, C., Fischer, H., Camacho, X., Rochon, P., & Anderson, G. (2011). Unplanned readmissions after hospital discharge among patients

identified as being at high risk for readmission using a validated predictive algorithm. *Open Medicine, 5*(2), e104 - e111.

Guba, E. G. (1990). *The paradigm dialog*. Newbury Park: SAGE Pulications.

Guharoy, R., Bradshaw, J., Churmusi, K., Baxter, S., Smith, A., Darko, W., . . . LaHart, A. (2007). Incidence of ADEs in patients readmitted within 30 days of discharge in a tertiary care teaching hospital. *Drug Use Issues and Actions.* Vol. 42. Retrieved July 19, 2010, from http://formularyjournal.modernmedicine.com/formulary/Feature+Articles/Incidence-of-ADEs-in-patients-readmitted-within-30/ArticleStandard/Article/detail/480433

Hall, J. M., Levant, S., & DeFrances, C. J. (2012). Hospitalization for congestive heart failure: Unites States, 2000-2010 *NCHS data brief*. Hyattsvile, MD: National Center for Health Statistics.

Hammer, J. B., & Ellison, K. J. (2005). Predictors of hospital readmission after discharge in patients with congestive heart failure. *Heart & Lung, 34*(4), 231-239. doi: 10.1016/j.hrtlng.2005.01.001

Hansen, L. O., Greenwald, J. L., Budnitz, T., Howell, E., Halasyamani, L., Maynard, G., . . . Williams, M. V. (2013). Project BOOST: effectiveness of a multihospital effort to reduce rehospitalization. *Journal of Hospital Medicine, 8*(8), 421-427. doi: 10.1002/jhm.2054

Hasan, O., Meltzer, D., Shaykevich, S., Bell, C., Kabai, P., Auerbach, A., . . . Schnipper, J. (2010). Hospital readmission in general medicine patients: a prediction model. *Journal of General Internal Medicine, 25*(3), 211 - 219.

Hasegawa, K., Tsugawa, Y., Camargo, C. A., & Brown, D. F. (2014). Frequent utilization of the Emergency Department for acute heart failure syndrome: a population-based study. *Circulation Cardiovascular Quality Outcomes, 7*, 735-742.

Hastings-Tolsma, M., Matthews, E. E., Nelson, J. M., & Schmiege, S. (2013). Comparative effectiveness research: nursing science and health care delivery. *Western Journal of Nursing Research, 35*(6), 683-702. doi: 10.1177/0193945912474501

Heart Failure Society of America. (version 3.6). About HFSA. Retrieved from http://www.hfsa.org/about-hfsa/

Heart Failure Society of America. (2010a). Executive summary: HFSA 2010 comprehensive heart failure practice guideline. *Journal of Cardiac Failure, 16*(6), 475-539. doi: http://dx.doi.org/10.1016/j.cardfail.2010.04.005

Heart Failure Society of America. (2010b). Section 8: disease management, advance directives, and end-of-life care in heart failure education and counseling. *Journal of Cardiac Failure, 16*(6), e98-e114. doi: http://dx.doi.org/10.1016/j.cardfail.2010.05.017

Henke.R.M., Karaca, Z., Hollis, L., Wier, L. M., Marder, W., & Wong, H. S. (2015). Patient factors contributing to variation in same-hospital readmission rate. *Medical Care Research and Review, 72*(3), 338-358.

Hines, A.L., Barrett, M.L., Jiang, H.J., & Steiner, C.A. (2014). *Conditions with the largest number of adult hospital readmissions by payer, 2011*. Retrieved from https://www.hcup-us.ahrq.gov/reports/statbriefs/sb172-Conditions-Readmissions-Payer.pdf

Ho, P., Bryson, C., & Rumsfeld, J. (2009). Medication adherence: its importance in cardiovascular outcomes. *Circulation, 119*(23), 3028 - 3035.

Hockenberry, J. M., Burgess, J. F., Glasgow, J., Vaughan-Sarrazin, M., & Kaboli, P. J. (2013). Cost of readmission: can the Veterans Health Administration (VHA) experience inform national payment policy? *Medical Care, 51*(1), 13-19. doi: 10.1097/MLR.0b013e31825c2fec

Holland, D. E., & Bowles, K. H. (2012). Standardized discharge planning assessments: impact on patient outcomes. *Journal of Nursing Care Quality, 27*(3), 200-208. doi: 10.1097/NCQ.0b013e31824ebc59

Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied Logistic Regression*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Houghton, C., Hunter, A., & Meskell, P. (2012). Linking aims, paradigm and method in nursing research. *Nurse Researcher, 20*(2), 34-39.

Howell, D. C. (2010). *Statistical Methods for Psychology* (7 ed.). Belmont, CA: Cengage Wadsworth.

Howell, K. E. (2013). *An introduction to the philosophy of methodology*. Los Angeles, CA: SAGE.

Hugli, O., Braun, J. E., Kim, S., Pelletier, A. J., & Camargo Jr, C. A. (2005). United States Emergency Department visits for acute decompensated heart failure, 1992 to 2001. *The American Journal of Cardiology, 96*(11), 1537-1542. doi: http://dx.doi.org/10.1016/j.amjcard.2005.07.064

Hulley, S. B., Cummings, S. R., Browner, W. S., D.G., G., & Newman, T. B. (2007). *Designing clinical research* (3 ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Hummel, S. L., Katrapati, P., Gillespie, B. W., DeFranco, A. C., & Koelling, T. M. (2014). Impact of prior admissions on 30-day readmissions in Medicare heart failure inpatients. *Mayo Clinic Proceedings, 89*(5), 623-630. doi: http://dx.doi.org/10.1016/j.mayocp.2013.12.018

Hyrkas, K., & Wiggins, M. (2014). A comparison of usual care, a patient-centred education intervention and motivational interviewing to improve medication adherence and readmissions of adults in an acute-care setting. *Journal of Nursing Management, 22*(3), 350-361. doi: 10.1111/jonm.12221

Imazio, M., Cotroneo, A., Gaschino, G., Chinaglia, A., Gareri, P., Lacava, R., . . . Trinchero, R. (2008). Management of heart failure in elderly people. *International Journal of Clinical Practice, 62*(2), 270-280.

Jack, B. W., Chetty, V. K., Anthony, D., Greenwald, J. L., Sanchez, G. M., Johnson, A. E., . . . Culpepper, L. (2009). A reengineered hospital discharge program to decrease rehospitalization. *Annuals of Internal Medicine, 150*, 178-187.

Jencks, S., Williams, M., & Coleman, E. (2009). Rehospitalizations among patients in the Medicare fee-for-service program. *New England Journal of Medicine, 360*(14), 1418 - 1428.

Jennings, D. L., Petricca, J. C., Yageman, L. H., ODell, K., & Kalus, J. S. (2006). Predictors of rehospitalization after acute coronary syndromes. *American Journal of Health-System Pharmacists, 63*(Feb 15), 367-372. doi: 10.2146/ajhp050243

Jensen, G. A. (2011). *Outcomes of heart failure discharge instructions.* (Ph.D.), University of Iowa. Retrieved from http://0-search.ebscohost.com.libus.csd.mu.edu/login.aspx?direct=true&db=c8h&AN=2012250449&site=ehost-live Available from EBSCOhost c8h database.

Jessup, M., Abraham, W. T., Casey, D. E., Feldman, A. M., Francis, G. S., Ganiats, T. G., . . . Yancy, C. W. (2009). 2009 focused update: ACCF/AHA guidelines for the diagnosis and management of heart failure in adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation, 119*(14), 1977-2016.

Jones, C. D., Holmes, G. M., Dewalt, D. A., Erman, B., Broucksou, K., Hawk, V., . . . Pignone, M. (2012). Is adherence to weight monitoring or weight-based diuretic self-adjustment associated with fewer heart failure-related emergency department visits or hospitalizations? *Journal of Cardiac Failure, 18*(7), 576-584. doi: http://dx.doi.org/10.1016/j.cardfail.2012.05.004

Jordan, J. E., Buchbinder, R., & Osborne, R. H. (2010). Conceptualizing health literacy from the patient perspective. *Patient Education and Counseling, 79*, 36-42.

Joynt, K. E., Orav, E. J., & Jha, A. K. (2011). Thirty-day readmission rates for Medicare beneficiaries by race and site of care. *Journal of the American Medical Association, 305*(7), 675-681.

Kalisch, B. A., Begeny, S., & Anderson, C. (2008). The effect of consistent nursing shifts on teamwork and continuity of care. *Journal of Nursing Administration, 38*(3), 132-137.

Kalisch, B. A., Landstrom, G. L., & Williams, R. A. (2009). Missed nursing care: errors of omission. *Nursing Outlook, 57*, 3-9. doi: 10.1016/j.outlook.2008.05.007

Kansagara, D., Englander, H., Salanitro, A., Kagen, D., Theobald, C., Freeman, M., & Kripalani, S. (2011). Risk prediction models for hospital readmission: a systematic review. *Journal of the American Medical Association, 306*(15), 1688 - 1698. doi: 10.1001/jama.2011.1515

Katon, W., & Ciechanowski, P. (2002). Impact of major depression on chronic medical illness. *Journal of Psychosomatic Research, 53*(4), 859-863. doi: http://dx.doi.org/10.1016/S0022-3999(02)00313-6

Kind, A. J., Smith, M. A., Frytak, J. R., & Finch, M. D. (2007). Bouncing back: patterns and predictors of complicated transitions 30 days after hospitalization for acute ischemic stroke. *Journal of American Geriatircs Society, 55*, 365-373.

Kind, A. J., Smith, M. A., Liou, J., Pandhi, N., Frytak, J. R., & Finch, M. D. (2008). The price of bouncing back: one-year mortality and payments for acute stroke patients with 30-day bounce-backs. *Journal of American Geriatric Society, 56*, 999-1005.

Kociol, R. D., Peterson, E. D., Hammill, B. G., Flynn, K. E., Heidernreich, P. A., Pina, I. L., . . . Hernandez, A. F. (2012). National survey of hospital strategies to reduce heart failure readmissions: findings from the get with the guidelines - heart failure registry. *Circulation*. doi: 10.1161/CIRCHEARTFAILURE.112.967406

Koelling, T., Johnson, M., Cody, R., & Aaronson, K. (2005). Discharge education improves clinical outcomes in patients with chronic heart failure. *Circulation, 111*(2), 179 - 185.

Kommuri, N., Johnson, M. L., & Koelling, T. M. (2012). Relationship between improvements in heart failure patient disease specific knowledge and clinical events as part of a randomized controlled trial. *Patient Education and Counseling, 86*, 233-238. doi: 10.1016/j.pec.2011.05.019

Krichbaum, K. E., Peden-McAlpine, C., Diemert, C., Koenig, P., Mueller, C., & Savik, K. (2010). Designing a measure of complexity compression in registered nurses. *Western Journal of Nursing Research, 33*(1), 7-25. doi: 10.1177/0193945910383877

Krumholz, H. M., Normand, S. L., & Wang, Y. (2014). Trends in hospitalizations and outcomes for acute cardiovascular disease and stroke, 1999-2011. *Circulation, 130*, 966-975.

Lambrinou, E., Kalogirou, F., Lamnisos, D., & Sourtzi, P. (2012). Effectiveness of heart failure management programmes with nurse-led discharge planning in reducing re-admissions: a systematic review and meta-analysis. *International Journal of Nursing Studies, 49*(5), 610-624. doi: http://dx.doi.org/10.1016/j.ijnurstu.2011.11.002

Lee, C. S., Moser, D., K,, Lennie, T. A., & Riegel, B. (2011). Event-free survival in adults with heart failure who engage in self-care management. *Heart & Lung, 40*, 12-20.

Lee, K. S., Lennie, T. A., Dunbar, S. B., Pressler, S. J., Heo, S., Song, E. K., . . . Moser, D. K. (2015). The association between regular symptom monitoring and self-care management in patients with heart failure. *Journal of Cardiovascular Nursing, 30*(2), 145-151.

Lorig, K., & Holman, H. (2003). Self-management education: history, definition, outcomes, and mechanisms. *Annals of Behavioral Medicine, 26*(1), 1-7. doi: 10.1207/S15324796ABM2601_01

Lum, H. D., Studenski, S. A., Degenholtz, H. B., & Hardy, S. E. (2012). Early hospital readmission is a predictor of one-year mortality in community-dwelling older Medicare beneficiaries. *Journal of General Internal Medicine, 27*(11), 1467-1474. doi: 10.1007/s11606-012-2116-3

Maas, M., & Delaney, C. W. (2004). Nursing process outcome linkage research: issues, current status, and health policy implications. *Medical Care, 42*(2), 40-48.

Madigan, E. A. (2008). People with heart failure and home health care resource use and outcomes. *Journal of Nursing & Healthcare of Chronic Illnesses, 17*(7b), 253-259.

Manojlovich, M., Sidani, S., Covell, C. L., & Antonakos, C. L. (2011). Linking staffing variables to adverse patient outcomes. *Nursing Research, 60*(4), 214-220. doi: 10.1097/NNR.0b013e31822228dc

McAlister, F. A., Youngson, E., Bakal, J. A., Kaul, P., Ezekowitz, J., & van Walraven, C. (2013). Impact of physician continuity on death or urgent readmission after discharge among patients with heart failure. *Canadian Medical Association Journal, 185*(14), E681–E689. doi: 10.1503/cmaj.13004

McHugh, M. D., & Ma, C. (2013). Hospital nursing and 30-day readmissions among Medicare patients with heart failure, acute myocardial infarction, and pneumonia. *Medical Care, 51*(1), 52-59.

McIlvennan, C. K., & Allen, L. A. (2014). Outcomes in acute heart failure: 30-day readmission versus death. *Current Heart Failure Reports, 11*(4), 445-452. doi: 10.1007/s11897-014-0215-7

Mertler, C. A., & Vannatta, R. A. (2005). *Advanced and Multivariate Statistical Methods*. Glendale, CA: Pyrczak Publishing.

Molloy, G. J., O'Carroll, R. E., Witham, M. D., & McMurdo, E. T. (2012). Interventions to enhance adherence to medications in patients with heart failure: a systematic review. *Circulation, 5*, 126-133. doi: 10.1161/CIRCHEARTFAILURE.111.964569

Mueller, S. K., Lipsitz, S., & Hicks, L. S. (2013). Impact of hospital teaching intensity on quality of care and patient outcomes. *Medical Care, 51*, 567-574.

Naylor, M. D., Bowles, K. H., McCauley, K. M., Maccoy, M., Maislin, G., Pauly, M., & Krakauer, R. (2013). High-value transitional care: translation of research into practice. *Journal of Evaluation in Clinical Practice, 19*(5), 727-733.

Needleman, J., Buerhaus, P., Pankratz, S., Leibson, C. L., Stevens, S. R., & Harris, M. (2011). Nurse staffing and inpatient hospital mortality. *New England Journal of Medicine, 364*, 1037-1045.

Nielsen, G. A., Bartely, A., Coleman, E., Resar, R., Rutherford, P., Souw, D., & Taylor, J. (2008). Transforming care at the bedside how-to guide: creating an ideal transition home for patients with heart failure. http://www.ihi.org

Nosbusch, J. M., Weiss, M. E., & Bobay, K. L. (2010). An integrated review of the literature on challenges confronting the acute care staff nurse in discharge planning. *Journal of Clinical Nursing, 20*, 754-774. doi: 10.1111/j.1365-2702.2010.03257.x

Pallant, J. (2013). *SPSS survival manual: a step by step guide to data analysis using IBM SPSS* (5 ed.). New York, NY: The McGraw-Hill Companies.

Penninx, B. W., Beekman, A., Honig, A., Deeg, D., Schoevers, R. A., van Eijk, J., & van Tilburg, W. (2001). Depression and cardiac mortality: results from a community-based longitudinal study. *Archives of General Psychiatry, 58*(3), 221-227.

Peterson, P. N., Campagna, E. J., Maravi, M., Allen, L. A., Bull, S., Steiner, J. F., . . . Masoudi, F. A. (2012). Acculturation and outcomes among patients with heart failure. *Circulation, 5*, 160-166. doi: 10.1161/CIRCHEARTFAILURE.111.963561

Piano, M. R., Prasun, M. A., Stamos, T., & Groo, V. (2011). Flexible Diuretic Titration in Chronic Heart Failure: Where Is the Evidence? *Journal of Cardiac Failure, 17*(11), 944-954. doi: http://dx.doi.org/10.1016/j.cardfail.2011.10.001

Polit, D. F., & Tatano Beck, C. (2012). *Nursing research: generating and assessing evidence for nursing practice* (9th ed.). Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins.

Polit, D. F., & Yang, F. M. (2016). *Measurement and the measurement of change*. Philadelphia: Wolters Kluwer.

Press, M. J., Scanlon, D. P., Navathe, A. S., Zhu, J., Chen, W., Mittler, J. N., & Volpp, K. G. (2013). The importance of clinical severity in the measurement of hospital readmission rates for Medicare beneficiaries, 1997-2007. *Medical Care Research and Review, 70*(6), 653-665. doi: 10.1177/1077558713496167

Ranasinghe, I., Wang, Y., Dharmarajan, K., Hsieh, A. F., Bernheim, S. M., & Krumholz, H. M. (2014). Readmissions after hospitalization for heart failure, acute myocardial infarction, or pneumonia among young and middle-aged adults: a retrospective observational cohort study. *PLOS Medicine, 11*(9), 1-18. doi: 10.1371/journal.pmed.1001737

Rathore, S. S., Wang, Y., Druss, B. G., Masoudi, M., F.A.,, & Krumholz, H. M. (2008). Mental disorders, quality of care, and outcomes among older patients hospitalized with heart failure. *Archives of General Psychiatry, 65*(12), 1402-1408.

Regalbuto, R., Maurer, M. S., Chapel, D., Mendez, J., & Shaffer, J. A. (2014). Joint Commission requirements for discharge instructions in patients with heart failure: is understanding important for preventing readmissions? *Journal of Cardiac Failure, 20*(9), 641-649.

Riegel, B., Dickson, V., Hoke, L., McMahon, J., Reis, B., & Sayers, S. (2006). A motivational counseling approach to improving heart failure self-care: mechanisms of effectiveness. *J Cardiovasc Nurs, 21*(3), 232 - 241.

Riegel, B., Moser, D. K., Anker, S. D., Appel, L. J., Dunbar, S. B., Grady, K. L., . . . Whellan, D. J. (2009). State of the science: promoting self care in persons with heart failure: a scientific statement from the American Heart Association. *Circulation, 120*(12), 1141-1163.

Riggs, J. S., & Madigan, E. A. (2012). Describing variation in home health care episodes for patients with heart failure. *Home Health Care Management & Practice, 24*(3), 146-152. doi: 10.1177/1084822311425958

Roe-Prior, P. (2007). Sociodemographic variables predicting poor post-discharge outcomes for hospitalized elders with heart failure. *MEDSURG Nursing, 16*(5), 317-321.

Roger, V. L. (2013). Epidemiology of heart failure. *Circulation Research, 113*, 646-659. doi: 10.1161/CIRCRESAHA.113.300268

Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Benjamin, E. J., Berry, J. D., Borden, W. B., . . . Shifan, D. (2012). Heart disease and stroke statistics - 2012 update: a report from the American Heart Association. *Circulation, 125*(1), e2-220.

Rosen, A. K., Chen, Q., Shin, M. H., O'Brien, W. O., Schwartz, M., Mull, H. J., . . . Borzecki, A. M. (2014). Medical and surgical readmission in the Veterans Health Administration. *Medical Care, 52*(3), 243-249.

Ross, J. S., Bernheim, S. M., Lin, Z., Drye, E. E., Chen, J., Normand, S. T., & Krumholz, H. M. (2012). Mortality and readmission at safety net and non-safety net hospitals for three common medical conditions. *Health Affairs (Millwood), 31*(8), 1739–1748. doi: 10.1377/hlthaff.2011.1028.

Ross, J. S., Mulvey, G. K., Stauffer, B., Patlolla, V., Bernheim, S. M., Keenan, P. S., & Krumholz, H. M. (2008). Statistical models and patient predictors of readmission for heart failure: a systematic review. *Archives of Internal Medicine, 168*(13), 1371-1386.

RWJF. (2011). RWJF program results report – transforming care at the bedside (pp. 1-74): Robert Wood Johnson Foundation.

Sayers, S. L., Hanrahan, N., Kutney, A., Clarke, S. P., Reis, B. F., & Riegel, B. (2007). Psychiatric comorbidity and greater hospitalization risk, longer length of stay, and higher hospitalization costs in older adults with heart failure. *Journal of American Geriatric Society, 55*, 1585-1591.

Sherer, A., Crane, P. B., Abel, W. M., & Efird, J. (2014). predicting heart failure readmissions. *Journal of Cardiovascular Nursing*.

Shirey, M. R., Ebright, P. R., & McDaniel, A. M. (2013). Nurse manager cognitive decision-making amidst stress and work complexity. *Journal of Nursing Management, 21*(1), 17-30. doi: 10.1111/j.1365-2834.2012.01380.x

Shu, C. C., Lin, Y. F., Hsu, N. C., & Ko, W. J. (2012). Risk factors for 30-day readmission in general medical patients admitted from the emergency department: a single centre study. *Internal Medicine Journal, 42*(6), 677-682. doi: http://dx.doi.org/10.1111/j.1445-5994.2011.02562.x

Silverstein, M. D., Qin, H., Mercer, S. Q., Fong, J., & Haydar, Z. (2008). Risk factors for 30-day hospital readmission in patients > 65 years of age *Baylor University Medical Center Proceedings, 21*(4), 363-372.

Sochalski, J., Jaarsma, T., Krumholz, H. M., Laramee, A., McMurray, J. J. V., Naylor, M. D., . . . Stewart, S. (2009). What works in chronic care management: the case of heart failure. *Health Affairs, 28*(1), 179-189. doi: 10.1377/hlthaff.28.1.179

Stamp, K. D., Flanagan, J., Gregas, M., & Shindul-Rothschild, J. (2014). Predictors of excess heart failure readmissions. *Journal of Nursing Care Quality, 29*(2), 115-123.

Steiner, C., Barrett, M., & Hunter, K. (2010). Hospital readmissions and multiple emergency department visits, in selected states, 2006–2007 In H. C. a. U. Project (Ed.), *Statistical Brief #90*. Rockville, MD: Agency for Healthcare Research and Quality.

Sterne, P. P., Grossman, S., Migliardi, J. S., & Swallow, A. D. (2014). Nurses' knowledge of heart failure: implications for decreasing 30-day re-admission rates. *MEDSURG Nursing, 23*(5), 321-329.

Stevenson, C. W., Pori, D., Payne, K., Black, M., & Taylor, V. E. (2015). Hearing the veterans voice in congestive heart failure readmissions. *Professional Case Management, 20*(4), 177-185.

Stimpfel, A., Lake, E. T., & Barton, S. (2013). How differing shift lengths relate to quality outcomes in pediatrics. *Journal of Nursing Administration, 43*(2), 95-100. doi: 10.1097/NNA.0b013e31827f2244

Stone, P. W., Du, Y., Cowell, R., Amsterdam, N., Helfrich, T. A., Linn, R. W., . . . Mojica, L. A. (2006). Comparison of nurse, system and quality patient care outcomes in 8-hour and 12-hour shifts. *Medical Care, 44*(1099-1106).

The Joint Commission. (2014). Specifications manual for national hospital inpatient quality measures. 2013B. from http://www.jointcommission.org/specifications_manual_for_national_hospital_inpatient_quality_measures.aspx

Titler, M. G., Dochterman, J., & Reed, D. (2004). *Guideline for conducting effectiveness research in nursing & other healthcare services*. Iowa City, IA: The University of Iowa College of Nursing Center for Nursing Classification & Clinical Effectiveness.

Titler, M. G., Jensen, G. A., Dochterman, J., Xie, X., Kanak, M. F., Reed, D., & Shever, L. L. (2008). Cost of hospital care for older adults with heart failure: medical, pharmaceutical, and nursing costs. *Health Services Research, 43*(2), 635-655. doi: 10.1111/j.1475-6773.2007.00789.x

Titler, M. G., Shever, L. L., Kanak, M. F., Picone, D. M., & Qin, R. (2011). Factors associated with falls during hospitalization in an older adult population. *Research and Theory for Nursing Practice, 25*(2), 127-152.

van Walraven, C., Wong, J., & Forster, A. J. (2012). LACE+ index: extension of a validated index to predict early death or urgent readmission after hospital discharge using administrative data. *Open Medicine, 6*(3), e80-e90.

VanSuch, M., Naessens, J. M., Stroebel, R. J., Huddleston, J. M., & Williams, A. R. (2006). Effect of discharge instructions on readmission of hospitalized patients with heart failure: do all of the Joint Commission on Accreditation of Healthcare Organizations heart failure core measures reflect better care? *Quality & Safety in Health Care, 15*(6), 414-417.

Vivo, R. P., Krim, S. R., Liang, L., Neely, M., Hernandez, A. F., Eapen, Z. J., . . . Fonarow, G. C. (2014). Short- and long-term rehospitalization and mortality for heart failure in 4 racial/ethnic populations. *Journal of the American Heart Association, 3*(5). doi: 10.1161/jaha.114.001134

Wakefield, B. J., Boran, S. A., Groves, P. S., & Conn, V. S. (2013). Heart failure care management programs: a review of study interventions and meta-analysis of outcomes. *Journal of Cardiovascular Nursing, 28*(1), 8-19.

Wang, X., Qiu, J., Ju, Y., Chen, C., Yang, J., Pang, J., & Zhao, X. (2014). Reduction of heart failure rehospitalization using a weight management education intervention. *Journal of Cardiovascular Nursing, 29*(6), 528-534.

Warden, B. A., Freels, J. P., Furuno, J. P., & Mackay, J. (2014). Pharmacy-managed program for providing education and discharge instructions for patients with heart failure. *American Journal of Health Systems Pharmacy, 71*(2), 134-139. doi: 10.2146/ajhp130103

Warner, R.M. (2013). *Applied statistics: from bivariate through multivariate techniqes* (2 Ed.). Thousand Oaks, CA: SAGE.

Watkins, T., Mansi, M., Thompson, J., Mansi, I., & Parish, R. (2013). Effect of marital status on clinical outcome of heart failure. *Journal of Investigative Medicine, 61*(5), 835-841. doi: 10.231/JIM.0b013e31828c823e

Weiss, M. E., Bobay, K., Bahr, S. J., Costa, L. L., Hughes, R. G., & Holland, D. E. (2015). A model for hosptial discharge preparation. *The Journal of Nursing Administration, 45*(12), 606-614.

Weiss, M. E., Costa, L. L., Yakusheva, O., & Bobay, K. (2014). Validation of patient and nurse short forms of the readiness for hospital discharge scale and their relationship to return to the hospital. *Health Services Research, 49*(1), 304-317.

Weiss, M. E., Yakusheva, O., & Bobay, K. L. (2011). Quality and cost analysis of nurse staffing, discharge preparation, and postdischarge utilization. *Health Services Research, 46*(5), 1473-1494. doi: http://dx.doi.org/10.1111/j.1475-6773.2011.01267.x

White, S.M., Hill, A. (2014). A heart failure initiative to reduce the length of stay and readmission rates. *Professional Case Management, 19*(6), 276-284.

White, M., Garbez, R., Carrol, M., Brinker, E., & Howie-Esquivel, J. (2013). Is "teach-back" associated with knowledge retention and hospital readmission in hospitalized heart failure patients? *Journal of Cardiovascular Nursing, 28*(2), 137-146.

Wiggins, B. S., Rodgers, J. E., DiDomenico, R. J., Cook, A. M., & Page, R. L. (2013). Discharge counseling for patients with heart failure or myocardial infarction: a best practices model developed by members of the American College of Clinical Pharmacy's cardiology practice and research network based on the hospital to home (H2H) initiative. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 33*(5), 558-580. doi: 10.1002/phar.1231

Wong, R., & Miller, W. (2008). Adverse outcomes following hospitalization in acutely ill older patients. *BioMed Central Geriatrics, 8*(1), 10.

Wu, J., Lennie, T. A., Chung, M. L., Frazier, S. K., Dekker, R. L., Biddle, M. J., & Moser, D. K. (2012). Medication adherence mediates the relationship between marital status and cardiac event-free survival in patients with heart failure. *Heart and Lung*, 41(*2*), 107-114. doi:doi:10.1016/j.hrtlng.2011.09.009

Wu, J., Lennie, T.A., Dunbar, S.B., Pressler, S.J., & Moser, D.K. (2017). Does the theory of planned behavior predict dietary sodium intake in patients with heart failure? *Western Journal of Nursing Research,* 39(*4*), 568-581. doi: 10.1177/0193945916672661

Yakusheva, O., Lindrooth, R. C., & Weiss, M. (2014a). Economic evaluation of the 80% baccalaureate nurse workforce recommendation: a patient-level analysis. *Medical Care, 52*(10), 864-869.

Yakusheva, O., Lindrooth, R. C., & Weiss, M. (2014b). Nurse value-added and patient outcomes in acute care. *Health Services Research, 49*(6), 1767-1786. doi: 10.1111/1475-6773.12236

Yancy, C., Jessup, M., Bozkurt, B., Butler, J., Casey Jr, D. E., Drazner, M. H., . . . Wilkoff, B. L. (2013). 2013 ACCF/AHA guidline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association task force on practice guidlines. *Circulation, June 5*, 241-327. doi: doi: 10.1161/CIR.0b013e31829e8776

Zai, A. H., Ronquillo, J. G., Nieves, R., Chueh, H. C., Kvedar, J. C., & Jethwani, K. (2013). Assessing hospital readmission risk factors in heart failure patients enrolled in a telemonitoring program. *International Journal of Telemedicine and Applications, April 27*, 1-6.

Zavala, S., & Shaffer, C. (2011). Do patients understand discharge instructions? Journal of Emergency Nursing, 37(2), 138-140.

The Model for Effectiveness Research

Copyrighted Figure

Used with Permission from Dr. Marita Titler

Titler, M.G., Dochterman, J., & Reed, D. (2004). *Guideline for conducting effectiveness research in nursing & other healthcare services.* Iowa City, IA: The University of Iowa College of Nursing Center for Nursing Classification & Clinical Effectiveness (Used with Permission)

Appendix A: Institutional Review Board Approval Forms

Good morning Becky,

In order for research studies conducted by MU faculty, staff or students to require review by the MU IRB, the study must meet the following 2 definitions:

1. "Research" defined as: A systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.

2."Human subjects" defined as: a living individual about whom an investigator (whether professional or student) conducting research obtains (1) data through intervention or interaction with the individual, or (2) identifiable private information.

Based on the activities described in your submission and subsequent email you will be receiving completely de-identified data extracts from the hospitals and health systems involved in your project. Because of this, your study would NOT meet the criteria for "Human Subject" as defined by the federal regulations and MU IRB review will not be required. Please retain this email for your records.

If anything should change, please contact me.

Good luck on your project,
Jessica

Jessica Rice, MPH
IRB Manager
Office of Research Compliance
Schroeder Complex, 102
Marquette University
PO Box 1881
Milwaukee WI 53201
Ph. (414) 288-6298, Fax: (414) 288-6281
http://www.marquette.edu/researchcompliance/

Aurora Health Care

Research Subject
Protection Program
945 N 12th St
PO Box 342 W310
Milwaukee, WI 53201-0342

T 414.219.7744
F 414.219.7477
RB.office@aurora.org

www.AuroraHealthCare.org

5/26/2016

Becky A Pogacar
3835 S Town Rd.
New Berlin, WI 53151

Dear Becky Pogacar:

The Aurora RSPP Office has received your proposal entitled *The Relationship of Exposure to Discharge Teaching to Heart Failure Readmission* on 5/17/2016. Based on the information you provided, it is the opinion of the IRB Chair that this proposal is exempt from IRB oversight [45CFR46.101(b)(4)] and may be carried out as you have indicated. As required by federal regulation, I will inform the Aurora IRB† of this action at the next meeting scheduled for 6/15/2016. Please note that IRB approval is not administrative approval, and you should ensure you have the approval of appropriate administrators before you conduct the study.

Thank you for bringing your proposal to the attention of the Aurora Research Subject Protection Program. If the plan or intent of your proposal changes in the future, this information should be brought to the attention of the Research Subject Protection Program to determine if IRB review would be required at that time. If you require further assistance, feel free to call Michelle Maternowski, Director of the Research Subject Protection Program.

Sincerely,

Michelle Maternowski, BS
Director, Research Subject Protection Program
Sent on behalf of Brian Weir, RPh, Chair, Aurora IRB

---

†***Aurora IRB Compliance Statement:*** The Aurora Health Care Institutional Review Boards (Aurora IRBs) comply with all applicable laws, guidelines, and federal regulations that oversee the operation of Institutional Review Boards, specifically 45CFR46 and 21CFR50 and 56, including International Conference of Harmonization E6 Good Clinical Practice guidance (ICH GCPs). The Aurora IRBs are duly constituted (fulfilling federal requirements for diversity), have written procedures for initial and continuing review of clinical trials, prepare written minutes of convened meetings, and retain records pertaining to the review and approval process. In accordance with these regulations [45CFR46.107(a) and 21CFR56.107(a)], the Aurora IRBs prohibit any member from participating in the IRB's initial or continuing review of any study in which the member has a conflicting interest, except to provide information requested by the IRB. Our policy is to require a voting member of the IRB to leave the room for final discussion and voting on a protocol in which the member is an investigator, or has any conflict of interest. In addition, the Aurora IRBs have received FULL accreditation by AAHRPP (valid through September 2016).

Aurora Research Institute™

May 5, 2016

Donna McCarthy, PhD, RN, FAAN
Interim Dean, Interim Associate Dean for Research/Professor
College of Nursing
Marquette University
1250 West Wisconsin Avenue
Milwaukee, Wisconsin 53233

RE: Aurora Research Institute, LLC ("ARI") Data Release to Marquette University ("School")

Dear Dr. McCarthy:

Thank you for your interest in working with ARI. ARI seeks the advancement of health care through research, clinical investigation and innovation in a manner consistent with its status as a non-profit tax-exempt institution. To further the state of medical knowledge pursuant to its mission, ARI is pleased to support Ms. Becky Pogacar's nursing research project, which is being conducted under the direction of her Doctoral Degree Dissertation Chair Ronda Hughes, PhD, MHS, RN, CLNC, FAAN, entitled The Relationship of Exposure to Discharge Teaching to Heart Failure Readmission ("Study") on the terms and conditions outlined in this letter agreement ("Agreement").

1. Data Elements. ARI shall provide a coded, de-identified data set that includes the data elements ("Data Elements") described in Attachment A for School's use for the Study. School shall use the Data Elements for purposes of the Study and no other purpose. Aurora shall not provide Protected Health Information, as that term is defined by the Health Insurance Portability and Accountability Act, to School and School shall not attempt to establish the identity of the subjects whose data is provided in the Data Elements.

2. DISCLAIMER OF WARRANTIES. NOTWITHSTANDING ANYTHING TO THE CONTRARY, ARI MAKES NO REPRESENTATIONS, WARRANTIES OR OTHER COMMITMENTS WHATSOEVER WITH RESPECT TO THE DATA ELEMENTS. SCHOOL UNDERSTANDS AND AGREES THAT ALL DATA ELEMENTS ARE PROVIDED ON AN "AS IS" BASIS, AND ARI EXPRESSLY DISCLAIMS ANY AND ALL REPRESENTATIONS, WARRANTIES AND OTHER COMMITMENTS WITH RESPECT TO THE DATA ELEMENTS, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING WITHOUT LIMITATION ANY REPRESENTATION, WARRANTY OR COMMITMENT THAT THE DATA ELEMENTS DO NOT INFRINGE OR VIOLATE THE INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY. SCHOOL SHALL BE SOLELY AND FULLY RESPONSIBLE FOR INDEPENDENTLY EVALUATING THE DATA ELEMENTS AND FOR ANY DECISION TO RELY UPON OR OTHERWISE USE THE DATA ELEMENTS.

3. LIMITATION OF LIABILITY. TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, THE TOTAL AGGREGATE LIABILITY OF ARI, REGARDLESS OF WHETHER SUCH LIABILITY IS BASED ON BREACH OF CONTRACT, TORT, STRICT LIABILITY, BREACH OF WARRANTIES, FAILURE OF ESSENTIAL PURPOSE OR OTHERWISE, UNDER THIS AGREEMENT OR WITH RESPECT TO THE DATA ELEMENTS SHALL BE LIMITED TO ONE HUNDRED DOLLARS ($100.00). IN NO EVENT WILL ARI BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, INDIRECT, PUNITIVE OR SPECIAL DAMAGES (INCLUDING LOSS OF PROFITS, DATA, BUSINESS OR GOODWILL), REGARDLESS OF WHETHER SUCH LIABILITY IS BASED ON

BREACH OF CONTRACT, TORT, STRICT LIABILITY, BREACH OF WARRANTIES, FAILURE OF ESSENTIAL PURPOSE OR OTHERWISE, AND EVEN IF ADVISED OF THE LIKELIHOOD OF SUCH DAMAGES.

4. Consideration. In exchange for the Data Elements, School shall present on its findings at ARI at the conclusion of the Study. Further, in all publications reporting the use of the Data Elements, School agrees to acknowledge ARI as the source of the Data Elements, subject to Section 5.

5. Use of Name. School agrees that it shall receive ARI's written approval prior to publishing or distributing any promotional materials that contain a reference to ARI. ARI reserves the right at all times to revoke its consent to the use of its name, logo or any other identifying information in any promotional materials or demonstration. In such event, School shall immediately stop such uses, and shall destroy all such materials. It is expressly understood that any dissertations or scholarly works that are not promotional in nature are not subject to this section, except that in the event ARI revokes its consent to the use of its name, logo or any other identifying information, School will thereafter refrain from using ARI's name, logo or other identifying information in all such works that have not already been published or accepted for publication at the time ARI's consent is revoked.

6. Presentation and Study Results. The School agrees that at the completion of the Study the results of the Study will be presented to ARI and that ARI will have the right to use the results of the Study for its own patient care, internal teaching, and noncommercial research purposes.

Please acknowledge receipt of this Agreement by signing below and returning a copy to Lee Banfi, Sponsored Program Specialist Senior, Aurora Research Institute, 960 North 12th Street, Milwaukee, Wisconsin 53233 or by sending an electronic (pdf) copy to lee.banfi@aurora.org. Should you have any questions, please call Lee Banfi at 414-219-4823 and he will gladly assist you.

Sincerely,

By: _____

Randall S. Lambrecht, PhD
Senior Vice President
President Aurora Research Institute

XOBA
5-5-16

****

ACKNOWLEDGEMENT:

By signing below and returning a copy of this Agreement to the address provided above, you agree to the terms and conditions herein.

Marquette University

Donna McCarthy, PhD, RN, FAAN
Interim Dean, Interim Associate Dean for Research/Professor
Marquette University - College of Nursing
530 North 16th Street
Milwaukee, Wisconsin 53233

Date: 5-11-16

While not a party to this Agreement, I have read this Agreement and I acknowledge my responsibilities herein.

Marquette University Student / **PhD**

Date: 5/9/2016