Transition to home study: the influence of interprofessional team shared mental models on patient post-hospitalization outcomes

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TRANSITION TO HOME STUDY: THE INFLUENCE OF INTERPROFESSIONAL TEAM SHARED MENTAL MODELS ON PATIENT POST-HOSPITALIZATION OUTCOMES

by

Kirstin Manges

A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Nursing in the Graduate College of The University of Iowa

May 2018

Thesis Supervisor:  Assistant Professor Patricia Groves
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This is to certify that the Ph.D. thesis of

Kirstin Manges

has been approved by the Examining Committee for the thesis requirement for the Doctor of Philosophy degree in Nursing at the May 2018 graduation.

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Amany Farag
Greg Stewart
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Andrea Wallace
To my mom, my first editor, most influential nursing instructor, and biggest supporter.
I stand on the shoulders of giants; lifted up by mentors, family, and friends.

K. Manges
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ABSTRACT

Background
The quality of team-based care impacts patient post-hospitalization outcomes, yet there is a gap in our understanding of how specific team processes impact patient post-hospitalization outcomes. Shared Mental Models (SMMs) is a team process from organizational psychology; it provides an understanding of how providers coordinate complex tasks as a team. SMMs are the team members’ organized knowledge needed for effective team performance. Military research shows that teams with more convergent SMMs have higher performance and better outcomes. In healthcare, patient discharge exemplifies an activity that requires a high level of coordination among interprofessional team members. Two relevant domains of SMMs are Taskwork SMM (team assessment of patient’s readiness for hospital discharge) and Teamwork SMM (quality of day of discharge teamwork). Because of the newness of SMM to healthcare, we lack measures to understand SMMs among interprofessional discharge teams.

Study Purpose & Aims
The purpose was to pilot a novel measurement approach assessing SMMs of discharge teams, and explore their relationships to patient 30-day post-hospitalization outcomes (quality of care transition and utilization of unplanned medical services). Aim 1 determined the content and degree of convergence of discharge teams’ SMMs (taskwork and teamwork). Aim 2 examined the relationship between discharge team SMMs and patient post-hospitalization outcomes.

Methods
A prospective longitudinal pilot study was used to examine the SMMs of 64 unique discharge events in three inpatient units at a single hospital. Discharge team members independently completed a questionnaire measuring the Teamwork SMM (using the Shared Mental Model Scale) and the Taskwork SMM (using the Discharge Provider-Readiness for Hospital Discharge Scale). Data were collected from the patient 30 days post-discharge to determine the quality of transition (using the Care Transition Measure or CTM-15) and use of unplanned utilization of medical services (unplanned readmission or ED visit). Interrater Agreement ($r_{agreement}$) was used to determine the SMM convergence (or level of agreement) among the discharge team. The relationship between SMMs and the quality of transition outcome ($n = 42$) was determined using standard regression analysis. Logistic regression was
used determine the relationship of SMMs with utilization of unplanned medical services \((n = 56)\).

**Results**

Overall, discharge teams reported high levels of Taskwork SMMs \((M = 8.46, SD = .91)\) and Taskwork SMM Convergence \((M = .90, SD = .10)\), indicating that the discharge team perceived and agreed that patients had high levels of readiness for hospital discharge. Discharge teams also reported having high-quality Teamwork SMMs \((M = 6.11, SD = 0.39)\) and Teamwork SMM Convergence \((M = .85, SD = .10)\), suggesting that most discharge teams perceived and agreed that high quality teamwork was provided during the discharge process. Discharge events from the three inpatient units significantly differed in their Teamwork and Teamwork SMM content and convergence scores. Discharge teams’ Teamwork SMMs and Taskwork SMMs were positively associated with the CTM-15 score, while controlling for key contextual factors \((t = 3.94, p = .001; t = 3.94, p = .001, \text{ respectively})\).

**Conclusion**

Discharge teams’ Taskwork SMM and Teamwork SMM was positively associated with patient-reported quality of transition from the hospital. There was insufficient evidence to support that utilization of unplanned medical services is related to discharge teams’ SMMs. Measuring the SMMs of the discharge team provides a method for assessing a team process critical to safe patient discharges.
Hospital discharge is a vulnerable and potentially dangerous transition that impacts approximately 35.1 million Americans each year. Failures in coordination among the inpatient healthcare team at discharge places older adults at increased risk for costly delays, unmet patient needs, adverse events, and preventable readmissions. Preparing patients for discharge requires multiple tasks that cross professional boundaries, which creates a high-risk situation of role ambiguity and diffuse responsibility among healthcare providers. Without a shared understanding among the healthcare team regarding the patient’s situation and the individual team members’ roles, lapses in care can occur, further placing patients at increased risk for harm post-hospitalization. The quality of team-based care impacts patient post-hospitalization outcomes, yet there is a gap in our understanding of how healthcare team processes impact patient post-discharge outcomes.

To address these gaps in the literature, a study was conducted at a single hospital to pilot an approach for measuring the impact of inpatient discharge teams on patient post-discharge outcomes. Specifically, a team process from organizational psychology (Shared Mental Models or SMMs) was used to examine how knowledge is shared and disturbed among the discharge team. Surveys were used to quantitatively measure interprofessional team shared understanding of patients’ readiness for hospital discharge or the Taskwork SMM, as well as the teams’ shared understanding of the quality of day teamwork when discharging patients or the Teamwork SMM. Data was collected from 64 patients, as well as their nurse, doctor, and discharge coordinator. The survey data was used to explore the relationships between SMMs and patient 30-day post-hospitalization outcomes.

A key study finding is that the patient’s reported quality of transition from the hospital was related to both the discharge teams’ assessment of the patient’s readiness for hospital discharge (Taskwork SMM), as well as the discharge teams’ reported quality of day of discharge teamwork (Teamwork SMM). This study is the first to examine both Teamwork and Taskwork SMMs in interprofessional healthcare teams, as well as to explore the link between the SMMs of discharge teams and patient post-hospitalization outcomes. The study advances healthcare systems science by providing a) a better understanding of how team processes influence patient outcomes; b) piloting a new approach for examining a critical team process (Shared Mental Models) of interprofessional discharge teams, and c) opportunities to identify effective team-based strategies to improve the quality of patient hospital discharges.
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LIST OF ABBREVIATIONS

ACA
Patient Protection and Affordable Care Act

AE
Adverse Event

AHRQ
Agency for Healthcare Research and Quality

BOOST
Better Outcomes for Older Adults through Safe Transitions

CDC
Centers for Disease Control and Prevention

CMS
Centers for Medicare & Medicaid Services

CTM
Care Transitions Measure

DC
Discharge Coordinator

EMRs
Electronic Medical Records

HCAHPS
Hospital Consumer Assessment of Healthcare Providers and Systems

HRRP
Hospital Readmission Reduction Program

ICD-9-CM
*International Classification of Diseases, Ninth Revision, Clinical Modification*

IOM
Institute of Medicine

IPO
Input-Process-Output Model

IMM
Individual Mental Model
MD
Doctor of Medicine

MD-RHDS
MD-Readiness for Hospital Discharge Scale

PCC
Patient-Centered Care

Project RED
Re-Engineered Discharge

PSI
Patient Safety Indicators

RHD
Readiness for Hospital Discharge

RHDS
Readiness for Hospital Discharge Scale

RN
Registered Nurse

RN-RHDS
Nurse-Readiness for Hospital Discharge Scale

SMM
Shared Mental Model

TCM
Transitional Care Model
CHAPTER 1
INTRODUCTION TO THE STUDY

Study Overview

Post-hospitalization safety is a major concern for patients, providers, and policymakers. Nearly one in five older adults experience an adverse event after hospital discharge (Forster, Murff, Peterson, Gandhi, & Bates, 2003; Forster et al., 2004). Failures in coordination among the inpatient healthcare team at discharge places older adults at increased risk for costly delays, unmet patient needs, adverse events, and preventable readmissions (Agency for Healthcare Research and Quality [AHRQ], 2012; Forster et al., 2003; Nosbusch, Weiss, & Bobay, 2011). Preparing patients for discharge requires multiple tasks that cross professional boundaries (Aase, Schibevaag, & Waring, 2017; Greysen et al., 2012; Kripalani, Jackson, Schnipper, & Coleman, 2007; Waring, Marshall, & Bishop, 2015). This creates a high-risk situation of role ambiguity and diffuse responsibility among healthcare providers (Waring et al., 2015). Without a shared understanding among the healthcare team regarding the patient’s situation and the individual team members’ roles, lapses in care can occur, further placing patients at increased risk for harm post-hospitalization (Popejoy, Moylan, & Galambos, 2009; Waring et al., 2015). It has been suggested that the quality of team-based care impacts patient post-hospitalization outcomes, yet there is a gap in our understanding of how healthcare team processes impact patient post-discharge outcomes (Greysen et al., 2012; Pinelli, Papp, & Gonzalo, 2015; Popejoy et al., 2009; Waring et al., 2015).

Shared mental model (SMM) is a concept from organizational psychology that provides a mechanism for examining how providers coordinate complex discharge tasks as a team (Mohammed, Ferzandi, & Hamilton, 2010). Healthcare teams discharging patients can simultaneously hold multiple SMMs that contain different types of relevant knowledge, including Teamwork SMMs (roles and responsibilities involved in discharging patients) and Taskwork SMMs (how ready the patient is for discharge; Cooke, Salas, Cannon-Bowers, & Stout, 2000; Mohammed, Hamilton, & Lim, 2009). A key property of SMMs is convergence, or the level of agreement among team members (Mohammed et al., 2009). Military research shows that teams with more convergent and accurate SMMs have higher teamwork capacity
and performance (Cannon-Bowers, Salas, & Converse, 1990; DeChurch & Mesmer-Magnus, 2010). These findings suggest that discharge teams with more convergent Teamwork and Taskwork SMMs may contribute to improved patient outcomes (DeChurch & Mesmer-Magnus, 2010). However, little is known about how knowledge is organized among inpatient discharge teams and whether provider SMMs are associated with patient outcomes.

To address these gaps in the literature, a quantitative prospective pilot study was conducted on three inpatient units (Cardiology, Orthopedic, and Medical) at a hospital in Iowa City, Iowa. Specifically, data were gathered from 72 discharge events using questionnaires in order to determine (a) the degree of convergence of discharge teams’ Teamwork and Taskwork SMMs; and (b) the relationship between discharge teams’ Teamwork and Taskwork SMMs and post-hospitalization outcomes. This study was innovative as it was the first to examine both Teamwork and Taskwork SMMs in interprofessional healthcare teams, as well as to explore the link between the SMMs of discharge teams and patient post-hospitalization outcomes. Understanding how team SMMs are related to patient post-hospitalization outcomes creates opportunities to identify effective team-based strategies in order to improve patients’ quality of transition from the hospital to home.

**Significance**

Hospital discharge is a vulnerable and potentially dangerous transition that affects approximately 35.1 million Americans each year (Centers for Disease Control and Prevention [CDC], 2010). Nearly one in five older adults has experienced an adverse event after hospital discharge, 70% of which were deemed preventable or ameliorable by addressing system factors (Forster et al., 2004). Addressing health system factors that place older adult patients at risk for adverse outcomes (e.g., readmission to acute care settings) could result in an estimated $12 billion in annual Centers for Medicare Services (CMS) savings (Medicare Payment Advisory Commission, 2008).

Numerous studies provide evidence that patients are frequently discharged from the hospital unprepared for self-management at home (Forster et al., 2004; Nosbusch et al., 2011; Pinelli et al., 2015; Waring et al., 2015). Despite the root causes of readmissions and unmet patient needs being complex and variable, research emphasizes that incomplete, inaccurate, or inaccessible information attenuates team coordination and contributes to unsafe patient discharge (Forster et al., 2004; Nosbusch et al., 2011; Pinelli et al., 2015;
Waring, Bishop, & Marshall, 2016). Further, qualitative studies investigating patient perspectives on the causes of unmet needs and readmissions identified a lack of discharge preparation, planning, and knowledge sharing by the healthcare team (Canary & Wilkins, 2017; Kripalani et al., 2007; Waring et al., 2015).

Due to the complexity of coordinating care, AHRQ recommends a team-based approach for high-risk transition points like hospital discharge (AHRQ, 2014). Readying patients for discharge is a time-sensitive, high-risk task requiring multiple healthcare professionals to concurrently assess the individual patient’s needs; work with the patient to formulate a care plan; provide education; and arrange transportation, home services, equipment, and medications (Aase et al., 2017; Goodman, Fisher, & Chang, 2013). Lapses can occur when providers and patients fail to effectively work together as a team (Canary & Wilkins, 2017; Pinelli et al., 2015; Popejoy et al., 2009; Waring et al., 2015; Waring et al., 2016), which can result in costly delays (Victor et al., 2000), premature discharge from the hospital (Victor, Healy, Thomas, & Sargeant, 2000), inadequate patient education or resources (Goodman et al., 2013), patient harm (Forster et al., 2003), and avoidable readmission (Nosbusch et al., 2011; Van Walraven, Bennett, Jennings, & Austin, 2011). However, team-based discharges are difficult to implement in practice because the discharge process is not standardized, and providers often lack a shared understanding of the discharge process and patient needs (Ashbrook et al., 2013; Canary & Wilkins, 2017; Greysen et al., 2012; Mitchell, Weigel, Laurens, Martin, & Jack, 2017; Waring et al., 2016). Evaluating hospital discharge team-based interventions is difficult because there are few methods available to examine the discharge process from a team perspective (Greysen et al., 2012; McDonald et al., 2007; Mitchell et al., 2017).

A critical task for the inpatient healthcare team is readying patients to engage in self-management after leaving the hospital (Weiss & Piacentine, 2006). It has been suggested that the discharge teams’ understanding of the patient’s readiness and team member roles/interactions impacts the team’s capacity to provide the appropriate timing of and activities (e.g., education, arranging resources) involved with, hospital discharge (Weiss, Costa, Yakusheva, & Bobay, 2014; Weiss & Piacentine, 2006). With the increased policy focus on improving the quality of care transitions to prevent readmissions, there is a need to identify how the inpatient team impacts post-discharge outcomes (Van Walraven et al., 2011).
There are several important post-discharge patient outcomes that are used by as indicators of inpatient quality of care delivery. For example, CMS and AHRQ use 30-day hospital readmission rates and unplanned utilization of medical services as post-discharge outcomes (Kripalani, Theobald, Anctil, & Vasilevskis, 2013). Readmission and unplanned utilization of medical services rates provide a crude measure of inpatient team performance, yet both require a large sample size (Committee of Presidents of Statistical Societies, 2012; Horwitz et al., 2011). Patient-centered outcomes, such as the Care Transitions Measure (CTM-15), provide an alternative approach to measuring team performance by focusing on capturing the quality of healthcare received from the patient’s perspective (Coleman, Mahoney, & Parry, 2008). The CTM-15 is endorsed by the National Quality Forum and assesses the extent to which hospital staff accomplished essential care processes (e.g., took patient’s preferences into consideration, developed a clear plan of care, taught warning signs and medications, arranged follow-up) in preparing the patient for discharge (Coleman et al., 2008; Parry, Mahoney, Chalmers, & Coleman, 2008). The CTM-15 provides a more proximal measure of inpatient discharge team performance than 30-day readmission and unplanned utilization by acting as a process measure for team actions during the hospital stay (Coleman et al., 2008).

In summary, this study is significant because frequent adverse events, costly hospital readmissions, and unmet patient needs in the post-hospitalization period indicate a need to re-examine how healthcare teams prepare patients for a safe transition home and how that preparation impacts patient outcomes (AHRQ, 2012; Ashbrook, Mourad, & Sehgal, 2010; Greysen et al., 2012). It has been suggested that the quality of team-based care affects patient post-hospitalization outcomes, yet there is a gap in our understanding of how healthcare team processes impact patient post-discharge outcomes (Greysen et al., 2012; Pinelli et al., 2015; Popejoy et al., 2009; Waring et al., 2015). In order to better analyze outcomes and aid development of specific team-based interventions that improve patient care a more nuanced understanding of how healthcare teams prepare patients for discharge is needed (AHRQ, 2014; Goodman et al., 2013). These barriers are addressed using an organizational psychology method to determine how healthcare providers share knowledge of team and tasks, allowing for the development of targeted interventions to improve interprofessional team care around discharge transitions.
Conceptual Underpinnings for the Study

Mental model theory is a useful framework to examine the team’s role in the discharge process. According to mental model theory, humans construct working cognitive models that continuously form associations among current perceptions of the environment, previous knowledge, and past experiences (Johnson-Laird, 1983). These individual mental models (IMMs) are cognitive structures that allow people to understand the bigger picture of the systems in which they function (e.g., communities, families, and work teams; Johnson-Laird, 1983). Human factors engineers have analyzed IMMs to (a) examine the cognitive thought processes involved in performing tasks, (b) identify best practices, and (c) assist in re-designing care processes (Burtscher & Manser, 2012; Johnson & Turley, 2006). However, analyzing IMMs has limited applications for complex team-dependent tasks because IMMs capture a single individual’s perspective. To understand cognition related to team-dependent tasks such as patient discharge, it is necessary to examine collective knowledge held by the team (Burtscher & Manser, 2012).

SMMs, an innovative approach from organizational psychology, can be used to quantitatively examine and measure interprofessional healthcare teams’ shared understanding of discharge (Burtscher & Manser, 2012; Mohammed et al., 2009). SMMs are defined as the organized understanding of relevant knowledge that is shared by the team members and provides a mechanism for examining how interprofessional teams cognitively coordinate complex tasks like discharge (Burtscher & Manser, 2012; Johnson & Turley, 2006; McComb & Simpson, 2014; Mohammed et al., 2009). As proposed in organizational psychology, a team’s SMM is more than the sum of each provider’s IMM (Mohammed et al., 2010): IMMs are aggregated to create a new team-level cognitive structure representing the shared knowledge held by the team (see Figure 1).
SMM content is linked to high team performance (Mohammed et al., 2010). Research examining high-performing military teams found that teams hold multiple SMMs containing different types of shared knowledge (Cannon-Bowers, Salas, & Converse, 1993). Two major SMM content domains are task-focused and team-focused. Teamwork SMMs contain knowledge of team members (expertise, preferences, strengths/weaknesses) and team interactions (roles/responsibilities, communication patterns, level of support; McComb & Simpson, 2014). Taskwork SMMs contain knowledge of the task situation (current status, expectations, what needs to be done; Mohammed et al., 2010). The purpose of the team determines the specific Teamwork and Taskwork SMM content. A review of the literature was used to identify two potentially important contents of discharge teams’ SMMs: knowledge of members’ roles and interactions (Teamwork SMM), and knowledge of the patient’s level of discharge readiness (Taskwork SMM; Cooke et al., 2000; Mohammed et al., 2009; Waring et al., 2015). Researchers have found that when task and team SMMs are accurate and appropriately apportioned, team members can (a) describe what is happening
and why; (b) create expectations for team member roles and tasks; and (c) formulate predictions for what might come next, resulting in better coordination of action and adaptation of behavior to team and task demands (Mohammed et al., 2010). Examining Teamwork and Taskwork SMMs is critical because both types of content can impact team performance.

The SMM of the interprofessional healthcare team can be quantitatively measured to determine the team’s level of shared understanding of vital aspects of the discharge process (Burtscher & Manser, 2012; Cannon-Bowers et al., 1993; Johnson & Turley, 2006; Lim & Klein, 2006; Mohammed et al., 2010). Teams that have convergent and accurate SMMs are often able to coordinate their actions implicitly (without needing to overtly communicate), even during times of urgency, high stress, and complexity (Mohammed et al., 2010). Additionally, research indicates that having an SMM of the task and team enables the teams to identify cues, make group decisions, adapt behavior, and respond appropriately (Burtscher & Manser, 2012; Cannon-Bowers et al., 1993; DeChurch & Mesmer-Magnus, 2010; Mohammed et al., 2010). There is widespread recognition that SMMs are a team-level property key to implicit coordination and team performance; however, few studies have examined SMMs in healthcare, and these have only focused on SMMs as an abstract concept (Burtscher & Manser, 2012; McComb & Simpson, 2014).

SMMs are used to identify how knowledge is distributed among the discharge team. The SMM properties of convergence and accuracy are linked to team performance in other fields but have yet to be examined in healthcare teams (Burtscher & Manser, 2012; Johnson & Turley, 2006). Convergence is the degree of overlap (or agreement) among IMMs of the team members (see Figure 1; Cutrer & Thammasitboon, 2012). Convergence can be used to identify how knowledge is distributed among the discharge team. At high-risk points of care, a team needs to have a convergent SMM of teamwork and taskwork to be able to safely care for patients (Burtscher & Manser, 2012; Johnson & Turley, 2006). It is important to examine the degree of convergence because the amount of knowledge overlap needed for effective teamwork in healthcare is unknown (Cooke et al., 2000; Millward & Jeffries, 2001), whereas accuracy represents the correctness of the team’s SMM compared to what is actually going on (Cannon-Bowers et al., 1993; Mohammed et al., 2010). SMM accuracy has implications for examining whether care is truly patient-centered by comparing team perceptions to patient perceptions (McComb & Simpson, 2014). Examining Teamwork and Taskwork
SMMs (convergence and accuracy) provides insight into how knowledge is distributed and suggests methods for evaluating the impact of a key critical team process on patient post-hospitalization outcomes.

This pilot study advances healthcare systems science by integrating concepts from patient safety, care transitions, and organizational psychology to identify a novel target for improving care around discharge transitions. SMMs are a critical team process to examine because the ability of the healthcare team to prepare patients for hospital discharge (e.g., provide education, arrange resources, and coordinate outpatient care) requires multiple providers to have an informed understanding of the patient’s situation and needs (Ashbrook et al., 2013). Piloting SMM measurement and describing factors that impact SMMs provide a first step towards identifying and evaluating strategies to assist interprofessional care teams prepare patients for a safe, high-quality, patient-centered hospital discharge.

**Conceptual Model**

This study utilizes an innovative conceptual model integrating discharge team literature and SMM concepts. The theorized relationships among SMMs, convergence, and patient post-hospitalization outcomes are illustrated in the conceptual model guiding this study (see Figure 2).

![Conceptual Model](Figure 2. Conceptual model illustrating theorized relationships among shared mental models (SMMs), convergence, and patient post-hospitalization outcomes.)
Gaps in the Literature

This study addresses a number of gaps in the existing literature. Although the role of teamwork has been identified as a major problem during hospital discharge and there is a push for providing team-based care, the role of specific team processes has not been rigorously examined. Additionally, SMMs are suspected to be integral to team-implicit coordination in healthcare; however, little is known about whether and how teams’ distribution of shared knowledge impacts teams’ ability to prepare patients for self-management after discharge (Ashbrook et al., 2013).

Current studies examining the hospital discharge process do not regularly include all key healthcare team providers, patients, and their shared roles and task knowledge (Aase et al., 2017; AHRQ, 2013; Ashbrook et al., 2013; Goodman et al., 2013). Thus, it is possible we do not have a full understanding of (a) provider roles in the discharge team and (b) the entire discharge task (Ashbrook et al., 2013; Pinelli et al., 2015). Extant literature has also focused only on individual perceptions, not on the performance of the team as it relates to their shared knowledge of discharge teamwork and taskwork (Ashbrook et al., 2013; Goodman et al., 2013; Nosbusch et al., 2011). Examining SMMs of the discharge team is an innovative approach to examining how interprofessional teams work in healthcare. These gaps in the literature will be addressed by developing methods to determine how healthcare providers share knowledge of team and tasks, thus allowing for the development of interventions to improve hospital discharge.

Methods to examine interprofessional team SMMs are needed to evaluate team-based interventions. Team-based interventions to improve patient transition to home include rounds, huddles, checklists, interprofessional or patient-centered care plans, as well as standardization and role delineation of the discharge process (AHRQ, 2012; Kripalani et al., 2007; Mitchell et al., 2017; Nosbusch et al., 2011; Parry et al., 2008). A common goal among these team-based interventions is that they aim to increase the inpatient team’s shared understanding of patient readiness for discharge and/or knowledge of the team member’s roles and interaction during hospital discharge. However, there is a lack of methods for determining how healthcare providers share knowledge of the team and tasks, which is critical for evaluating the fidelity of team-based interventions (McDonald et al., 2007; Nosbusch et al., 2011). This study develops an approach for measuring discharge teams’ SMMs that can be used in practice and research to evaluate team-based interventions.
Study Purpose

The purpose of this pilot study was to examine the content of SMM (taskwork and teamwork) among the inpatient discharge team members (i.e., nurse, attending physician, and discharge coordinator) and the influence of SMMs on patients’ 30-day post-hospitalization outcomes (e.g., quality of care transition and utilization of unplanned medical services).

Research Aims and Questions

Aim 1. Describe the degree of convergence for discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units.

• **Question 1A.** What are the teams’ average Teamwork SMM and Teamwork SMM Convergence scores among the members’ individual mental models at the time of patient discharge?

• **Question 1B.** What are the teams’ average Taskwork SMM and Taskwork SMM convergence scores among the members’ individual mental models at the time of patient discharge?

• **Question 1C.** Is there a difference among the inpatient units mean scores for a) Teamwork SMMs, b) Teamwork SMM Convergence, c) Taskwork SMMs, and/or Taskwork SMM Convergence?

Aim 2. Determine the relationship between discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units and patient 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services) while controlling for contextual unit and patient characteristics.

• **Question 2A.** After controlling for contextual unit and patient characteristics, is there a relationship between Teamwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); if so, is that relationship modified by the degree of Teamwork SMM convergence?

• **Question 2B.** After controlling for contextual unit and patient characteristics, is there a relationship between Taskwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); if so, is that relationship modified by i) the degree of Taskwork SMM convergence and/or ii) Taskwork accuracy?
CHAPTER 2
REVIEW OF THE LITERATURE

The Problem
This section provides an overview of the problems associated with poor teamwork during the process of discharging a patient from the hospital to home. Specifically, I first focus on the unmet needs of patients preparing for discharge, post-hospitalization adverse events, and readmission. Then, I highlight challenges facing hospitalized older adults returning home. Last, I provide an overview of the drivers and barriers to improving the discharge process.

Scope of the Problem
Hospital discharge can be a high-risk transition experienced by 35.1 million Americans each year (CDC, 2010). Fragmented healthcare services create a care coordination challenge for patients. In the United States, patients in need of immediate and time-sensitive medical action are hospitalized to receive acute care by an inpatient healthcare team (Popejoy et al., 2009). Non-acute care is ideally managed in the community setting by a separate primary healthcare team. Although both inpatient and outpatient services provide essential components of patient care, they have little communication with each other in the design of the current healthcare system (Popejoy et al., 2009). The minimal communication occurring between providers in the acute and non-acute settings creates a dangerous gap in patient care (Kripalani et al., 2007; Waring et al., 2016). The patients are often the only link between acute care and community settings and are largely responsible for coordinating and self-managing their care (Popejoy et al., 2009). The lack of continuity of care among care providers can make hospital discharge a high-risk transition for patients.

Unmet patient needs post-hospitalization. Patients are frequently discharged from the hospital with unmet needs, inadequate resources, and inappropriate preparation for self-management of care at home. Research shows that patients are often discharged without understanding key aspects of their care, including knowledge of discharge diagnosis, what to expect once home, knowledge about medications, and knowing whom to contact with questions (Arora et al., 2010; Bauer, Fitzgerald, & Koch, 2011; Canary & Wilkins, 2017; Clark et al., 2013; Fuji et al., 2013; Goodman et al., 2013; Hesselink, Schoonhoven, Plas, Wollersheim, & Vernooij-Dassen, 2013). For example, Horwitz et al. (2013) performed a
prospective observational cohort survey study and found that of 395 older adult patients, only 59.6% could accurately describe their diagnosis, despite 95.5% stating they understood the reason for hospital admission. The Holland and Hemann (2011) prospective cohort survey of 130 cognitively intact older adults identified that nearly one in four patients reported unmet physical needs that could have been addressed before discharge. Numerous studies provide evidence that patients and families are unprepared for self-management of care at home, which leads to a poor quality of transition home and a variety of problems after discharge, including difficulties with activities of daily living, medication and pain management, trouble accessing community healthcare providers, and unmet emotional needs (Bull, 2000; Canary & Wilkins, 2017; Connolly et al., 2009; Greysen, Garcia, Sudore, Cenzer, & Covinsky, 2014; Holland & Harris, 2007; Holland & Hemann, 2011; Mistiaen, Francke, & Poot, 2007; Moore et al., 2011; Naylor, 2002; Slieper, Hyle, & Rodriguez, 2007; Waring et al., 2016).

Qualitative studies investigating the sources of unmet needs from the patient’s perspective indicate a lack of discharge preparation and planning by the healthcare team (Canary & Wilkins, 2017; Coleman et al., 2005; Coleman et al., 2013; Corser, 2006; Fuji et al., 2013; Hesselink et al., 2013; Horwitz et al., 2013). A common theme identified in a Coleman et al. (2005) older adult focus group study included the lack of patient-centered planning. For example, patients felt that the healthcare team often developed post-hospitalization plans without consulting patients/families to determine the feasibility of the plan and that providers left patients “in the dark” about what to anticipate upon returning home (Coleman et al., 2005). Additionally, qualitative studies have shown that patients felt discharge planning and education were rushed, unclear, and uncoordinated (Canary & Wilkins, 2017; Corser, 2006; Fuji et al., 2013; Goodman et al., 2013). In a focus group study with providers and pediatric patients’ parents, Canary and Wilkins (2017) identified “missed interactions,” or the missed opportunity for discharge planning due to gaps in teamwork, as the primary source of problems associated with hospital discharge. Patients reported hearing conflicting directions from multiple healthcare providers, even on the day of hospital discharge (Fuji et al., 2013). The healthcare team’s failure to prepare patients for discharge is deeply concerning and indicates a need for a team-based, patient-centered approach to improve the discharge process.
Post-hospitalization adverse events. Patients are at risk for adverse events related to hospital discharge. A classic prospective cohort study (Forster et al., 2004) examined the incidence and severity of adverse events (AE) experienced by 361 older adult medical patients and found that nearly one in five patients ($n = 83$ or 23%) experienced at least one adverse event within 30 days post-hospitalization. Of the patients experiencing adverse events, 6% ($n = 23$ of AE) were found to be preventable and 6% ($n = 23$ of AE) were ameliorable by addressing system-level factors (Forster et al., 2004). Examples of the most common adverse events included drug events (72%), therapeutic errors (16%), nosocomial infections (11%), procedure-related problems (7%), pressure ulcers (7%), and falls (2%; Forster et al., 2004). The AEs ranged in severity, with some patients experiencing symptoms only (68%) to symptoms associated with a non-permanent disability (28%) to permanent disability (3%) and even death (3%).

The results from Forster et al. (2004) are comparable to other studies examining hospital discharge-related adverse events (Davenport et al., 2009; Forster et al., 2003; Moore, Wisnivesky, Williams, & McGinn, 2003; Mull et al., 2014; Roy et al., 2005). The Moore et al. (2003) retrospective chart review study of 86 medical patients found that following hospital discharge, nearly half (49%) of hospitalized patients experienced at least one medical error in medication continuity, diagnostic workup, or test follow-up. It has been estimated that 12% to 17% of older medical patients experience an adverse drug event after discharge, with a large percentage of these events being potentially preventable (Forster et al., 2004; Forster, Andrade, & van Walraven, 2005). However, due to the large number of medication changes for older adults during hospital stays, it is unknown exactly how many adverse drug events occur for this population (AHRQ, 2012). Patient safety during the post-hospitalization period is a serious quality of care concern, and precautions should be taken to reduce and prevent patient risk for harm after hospitalization (Forster et al., 2003; Forster et al., 2004; Forster et al., 2005; Moore et al., 2003).

Hospital readmission. In addition to encountering adverse events during the post-hospitalization period, many patients require re-hospitalization or readmission. The CMS, the Institute of Medicine (IOM), and The Joint Commission frequently use hospital readmissions as indicators of care quality (Goodman et al., 2013). Nearly 2 million Medicare beneficiaries are readmitted within 30 days of being released from the hospital, costing Medicare an estimated $26 billion annually (Gerhardt et al., 2013). While some patients
inevitably return to the hospital for planned or unpredictable reasons, many of these readmissions can be avoided (Goodman et al., 2013). The causes of readmissions, post-hospitalization adverse events, and unmet patients’ needs are complex, and exact causes are poorly understood (Alper, O’Malley, Greenwald, Aronson, & Sokol, 2013; Bull, 2000; Connolly et al., 2009; Holland & Hemann, 2011; Mistiaen et al., 2007; Moore et al., 2011; Naylor, 2002; Slieper et al., 2007). Yet beyond patient-level characteristics, research indicates that system factors, such as lack of coordination, miscommunication, and unstandardized discharge practices, impact discharge adverse events and hospital readmissions (Anthony et al., 2005; Forster et al., 2003; Goodman et al., 2013; Greysen et al., 2012; Horwitz et al., 2013; Jiang et al., 2016).

**Older adults’ post-hospitalization risks.** The older adult population is particularly vulnerable during the transition period from the hospital to home. Older adults experience high rates of morbidity and healthcare usage and require careful coordination of care by multiple healthcare providers (Allen et al., 2012). In 2008, patients 65 years and older comprised less than 13% of the population in the United States, yet represented 40% of hospitalized adults and nearly half of all healthcare dollars spent on hospitalization (Mattison, Marcantonio, Schmader, Gandhi, & Sokol, 2012). By 2030 there will be 70 million adults aged 66 and older, roughly double the current population (Vincent & Velkoff, 2010). Poor quality discharges and hospital readmissions are especially costly to both older adults and the healthcare system as a whole.

Older adults experience complex physical and social challenges, placing them at uniquely high risk during the discharge transition period. Older adults often live alone, have multiple chronic conditions and functional limitations, and heavily rely on other family members to provide care (Popejoy et al., 2009). Shortened length of stay, coupled with the nature of problems experienced during hospitalization (e.g., delirium, deterioration in functional status), make discharging older adult patients challenging for the inpatient team, particularly if systems are not in place to ensure continuity of care between the acute care setting and the community (Popejoy et al., 2009). The problem is compounded by the greater prevalence of chronic disease in older adults, which can require careful management by multiple inpatient and outpatient teams (Mattison et al., 2013). Additionally, during the immediate discharge period, older adults are at high risk for limited access to healthcare providers, as well as functional decline, falls, delirium, infection, malnutrition, venous
thrombosis, and medication errors (Mattison et al., 2013). Careful assessment of patient needs, planning, and coordination during the discharge process is needed to help older adults transition safely home from the hospital.

**Drivers and barriers to improving hospital discharge.** Readying patients for discharge is a time-sensitive, high-risk task requiring multiple healthcare professionals to concurrently assess the individual patient’s needs; work with the patient to formulate a care plan; provide education; and arrange transportation, home services, equipment, and medications. Lapses occur when providers and patients fail to work as a team, resulting in costly delays, premature discharge, inadequate patient education or resource planning, patient harm, and avoidable readmission (AHRQ, 2012; Greysen et al., 2012; Popejoy et al., 2009). Due to the high-risk nature of hospital discharge, AHRQ (2012) recommended using a team-based approach to care and identified three essential components to ensure safe patient discharge. These include (a) patient education, (b) medication reconciliation, and (c) structured discharge communication (e.g., following up with lab results or communication with primary care provider). Although these three components have been identified as important for patient safety, research indicates that these are frequently missing, incomplete, or ineffectively delivered in practice (AHRQ, 2012; Hesselink et al., 2013; Jiang et al., 2016).

The rationale given by healthcare providers for essential discharge components not occurring in current practice includes role confusion; competing priorities; and the lack of standardized processes, time, and accountability (Coleman et al., 2013; Fuji et al., 2013; Goldman et al., 2015; Greysen et al., 2012; Hesselink 2013; Jiang et al., 2016; Waring et al., 2016). The tasks required to prepare patients for discharge cross professional boundaries, which creates a situation of role ambiguity and diffuse individual responsibility for completing tasks (Greysen et al., 2012; Waring et al., 2016; Waring et al., 2015). Without communication and clear role definitions of who is doing what, lapses in care can occur, placing patients at increased risk for unmet needs and potential harm post-hospitalization (Ashbrook et al., 2013). Importantly, studies indicate that healthcare providers want a more in-depth understanding of the discharge process so they can understand how their role fits into providing high-quality discharges for patients (Fuji et al., 2013; Greysen et al., 2012; Waring et al., 2016).

Recent policy shifts are creating a focus on hospital readmissions and improving the quality of the discharge process. Addressing health system factors placing older adult
patients at risk for adverse outcomes, including readmission to acute care settings, could result in $12 billion in annual Medicare savings (Medicare Payment Advisory Commission, 2009). Previously, hospitals received more money for readmitting patients rather than preventing rehospitalization. In 2010, the Patient Protection and Affordable Care Act (2010) sparked awareness of the significant readmission problem in the United States by imposing significant financial penalties for hospitals with high readmission rates for certain types of Medicare patients. CMS, The Joint Commission, and AHRQ identified avoidable readmissions as one of the leading problems that the U.S. healthcare system faces. Reducing avoidable hospital readmissions presents an actionable opportunity for providers, payers, and policymakers to work together to reduce overall healthcare costs while simultaneously increasing the quality of patient care (AHRQ, 2012; Gerhardt et al., 2013; Medicare Payment Advisory Commission, 2009). As a result, providers, researchers, and hospital administrators are focusing on reducing readmission by identifying best practices to improve the quality of care provided during the discharge process (Goodman et al., 2013).

Frequent adverse events, costly hospital readmissions, and unmet patient needs in the post-hospitalization period call for reexamining how healthcare teams prepare patients for post-hospitalization and how that preparation impacts post-hospitalization patient outcomes (AHRQ, 2012; Ashbrook et al., 2013; Greysen et al., 2012).

Addressing the Problem

Awareness of the problems that patients experience after being hospitalized and the importance of preparing patients for hospital discharge have been recognized in the literature for over 50 years. This section of the literature review will provide an overview of how researchers have approached studying and addressing problems that patients experience during the transition from the hospital to home. First, I will provide a brief overview of the theoretical frameworks used to examine the hospital discharge process. Then, I will use Meleis’ transition theory as an organizational framework to describe common approaches to studying patterns of responses (e.g., readmissions, adverse events, and patient-centered outcomes), as well as therapeutic interventions.

Theoretical Frameworks

There are several theoretical frameworks that can be used to identify critical components of the discharge process. An overview of five theoretical frameworks for hospital discharge is presented in Table 1 (Congdon, 1994; Pethybridge, 2004; Potthoff,
Kane, & Franco, 1997; Weiss et al., 2008; Weiss et al., 2015). Although the authors developed these theories to serve different purposes, there are several shared characteristics across the frameworks.

First, all of the theoretical frameworks identify hospital discharge as (a) a critical time in patient care and (b) a transitional process that occurs over time (i.e., involves a hospitalization phase, leaving hospital, and post-hospitalization phase). A second commonality is that the discharge process involves a partnership with the patient, the family, and the healthcare team in order to prepare the patient to safely self-manage care at home. Examples of elements of discharge preparation include assessing patient needs (Congdon, 1994; Pethybridge, 2004; Potthoff et al., 1997; Weiss et al., 2007; Weiss et al., 2015), decision making (Congdon, 1994; Pethybridge, 2004; Potthoff et al., 1997), planning (Congdon, 1994; Potthoff et al., 1997; Pethybridge, 2004; Weiss et al., 2015), and teaching (Congdon, 1994; Potthoff et al., 1997; Weiss et al., 2007; Weiss et al., 2015). Last, communication and teamwork among the healthcare team are identified as critical components of preparing the patient for hospital discharge (Archie & Borem, 2009; Congdon, 1994; Pethybridge, 2004; Potthoff et al., 1997; Weiss et al., 2008; Weiss et al., 2015). Notably, although communication and teamwork are considered to be important, these theories do not describe how the healthcare team functions together to facilitate the discharge process.
<table>
<thead>
<tr>
<th>Author(s), Year</th>
<th>Development Approach</th>
<th>Purpose</th>
<th>Components</th>
</tr>
</thead>
</table>
| Congdon, 1994  | Grounded theory      | Describe the experience of elderly patients being discharged from the hospital | Central theme: Managing incongruities  
- Diversity of readiness for discharge among stakeholders  
- Family support  
- Missing patients/families in decision making |
| Potthoff, Kane, & Franco, 1997 | Case study integrated with a decision-making framework | Describe the components of discharge planning process |  
- Screening for discharge planning/needs  
- Assessment  
- Choice for post-acute modality & post-acute vendors  
- Implementation of post-discharge care plan  
- Evaluation |
| Pethybridge, 2004 | Grounded theory | Describe factors that influence decision making for patients from an interprofessional perspective | Central theme: Discharge decision making  
- Leadership, teamwork, & communication  
- Patient, family, providers’ behaviors, feelings, & resources |
| Weiss, Piacentine, Lokken, Ancona, & Archer, 2007 | Applied Meleis’ transition theory to discharge | Identify factors that influence readiness for hospital discharge |  
- Hospitalization factors (planned or prior admission, length of hospital stay)  
- Patient characteristics (age, gender, race, socioeconomic status, payer, and living alone)  
- Nursing therapeutics  
- Discharge teaching and care coordination  
- Patterns of response  
- Readiness for hospital discharge, post-discharge coping, utilization of post-discharge support and services |
| Weiss, Bobay, & Bahr, 2015 | Synthesis of literature | Organize the components of hospital discharge preparedness | Discharge planning  
- Assessment and planning for discharge needs  
- Estimation of readmission risk  
- Discharge coordination  
- Arrangements for support  
- Discharge teaching  
- Educational interventions |
Meleis’ Transition Theory

Meleis’ transition theory is a particularly useful framework to examine factors associated with hospital discharge from a patient-centered perspective. Meleis’ transition theory proposes that a major function of nursing is to help patients manage life transitions (Chick & Meleis, 1986), with transitions defined as “the passage or movement from one state, condition, or place to another” (p. 237). As a middle-range theory, the theory examines transitions as an abstract concept. However, the theory has been used in nursing studies to examine the transition from the hospital to home (Weiss et al., 2007). For example, transition theory has been used as a framework to identify factors that influence readiness for hospital discharge (Weiss et al., 2007; see Table 1), to develop tools to assess readiness for hospital discharge (Weiss et al., 2008), and to inform the development of evidence-based transitions practice models like the Transitional Care Model (Naylor et al., 2010).

The purpose of transition theory is to identify the relationships among the essential components of transitions. Starting in the mid-1970s, Meleis and colleagues began developing the transition theory through a review of the literature and concept analysis (Meleis, 1975; Meleis, Sawyer, Im, Messias, & Schumacher, 2000; Schumacher & Meleis, 1994), as well as performing a series of studies examining a wide range of transitional experiences including becoming a mother (Sawyer, 1999), experiencing menopause (Im & Meleis, 1999), developing a chronic illness (Messias 1997), and taking on a family caregiving role (Schumacher, 1996). Based on these works (Chick & Meleis, 1986; Meleis & Trangenstein, 1994; Schumacher & Meleis, 1994) and the description of the midrange transition theory (Meleis et al., 2000), I inferred the following major assumptions:

- Transitions involve a process of movement and changes in fundamental life patterns that are manifested in all individuals (Meleis et al., 2000).
- Transitions are complex, multidimensional, and have patterns of responses (Meleis et al., 2000, p. 57).
- Transitions “denote a change in health status, in role relations, in expectations or in abilities…with a unique constitution of patterns of responses over a span of time” (Meleis et al., 2000, p. 67).
- A primary goal of healthcare providers (nursing) is “to help people go through healthy transitions to enhance healthy outcomes” (Meleis, 1975, p. 5)
Transition theory describes the relationships among four key concepts of healthy transitions: nature of transition, transition conditions, nursing therapeutics, and patterns of response. Nature of transitions describes the type, pattern, and properties of transitions. Transition conditions are personal and environmental factors that facilitate or inhibit the progression towards a healthy transition. Examples of personal transition conditions identified by Meleis et al. (2000) included meaning attributed to the event, cultural beliefs and attitudes, socioeconomic status, and preparation and knowledge. Patterns of response are indicators of a healthy transition. Due to the temporal nature of transitions, indicators consist of both processes and outcomes. For example, patterns of responses for the process include feeling connected, interacting, being situated, and developing confidence and coping (Meleis et al., 2000). An example of an outcome indicator is the mastery of new skills needed to manage the transition. Last, therapeutics are the preventative and promotional actions taken to facilitate healthy transitions.

Transition theory provides a framework to determine outcomes of transitions and identify the role of healthcare providers in facilitating transitions. As outlined in the problem overview, patients are at risk for experiencing unhealthy transitions, including poor self-management of care, adverse events, and readmissions, after being discharged from the hospital to home. Understanding the nature of the transition, identifying the transition, facilitating/inhibiting conditions, and examining patterns of patient responses are essential to develop targeted interventions that prevent unhealthy transitions and promote patient self-management of care at home (Meleis et al., 2000). In the following section, transition theory is used as an organizational framework for describing how the discharge transition process is currently being studied. A summary is provided in Table 2.
<table>
<thead>
<tr>
<th>Transition Theory Concept</th>
<th>Transition Nature</th>
<th>Transition Conditions</th>
<th>Patterns of Response</th>
<th>Therapeutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Descriptors of the type, pattern, and properties of transition</td>
<td>Personal or environmental conditions that facilitate or hinder progression towards achieving transition</td>
<td>Process and outcome indicators of a healthy transition (i.e., patient's feelings of confidence and competence, as well as mastery of skills)</td>
<td>Prevention &amp; promotional actions to facilitate the transition experience (assessment, preparing, role supplementation)</td>
</tr>
</tbody>
</table>

**Links to the literature**

**Examples from the literature**

**Hospitalization Factors**
- Patient diagnosis
- Severity of illness
- Planned admission
- Previous hospitalization or ED visit
- Previous admission for the same condition
- Length of hospitalization
- Number of medications
- Number of co-morbidities

**Patient Characteristics**
- Sex
- Race
- Socioeconomic status
- Insurance payer
- Marital status
- Support
- Living alone
- Education

**Provider Characteristics**
- Communication quality
- Knowledge of the discharge process
- Familiarity with team members

**Hospital Readmissions**
- Planned vs. unplanned
- Preventable

**Adverse Events**
- Drug events
- Infections
- Pressure ulcers
- Falls
- Missing follow-up
- Death

**Discharge Readiness (RHD)**
- Personal status
- Knowledge
- Coping ability
- Expected support

**Quality of Preparedness**
- Self-management Preparation
- Understanding
- Team’s respect for individual
- Written care plan

**Assessment**
- Providers’ assessment RHD
- Assessment of risk for hospital readmission

**Preparing patient for SMPD - Inpatient**
- Discharge instructions
- Medication reconsolidation
- Discharge teaching

**Role supplementation - Outpatient**
- Follow-up phone call
- Home visits
- Tele-health

**Transition Bundles**
- Transition Care Model
- BOOST
- Project RED
- Care Transitions
Response Patterns to the Discharge Transition

Transition theory describes a pattern of responses as indicators of a healthy transition: patients’ feelings of confidence and competence, as well as mastery of skills for a healthy transition (Meleis et al., 2000). Through a review of the literature, I identified three frequently examined patterns of responses to the discharge transition: hospital readmissions, adverse events post-hospitalization, and patient-centered outcomes. These patient patterns of responses to the transition from the hospital to home are discussed in the following section.

Hospital readmissions. Hospital readmissions are the most commonly used outcome variable in research, quality improvement, and intervention studies related to hospital discharge. A major driver for studying readmissions is the recent change in national healthcare policy. In 2010, Section 1886(q) of the Patient Protection and Affordable Care Act formed the Hospital Readmission Reduction Program (HRRP), which as of 2012 requires CMS to reduce payment to acute care services that have high rates of readmission within 30 days of discharge for a select number of medical conditions (CMS, 2016). CMS defines readmission as an admission to a subsection hospital within 30 days of a discharge from the same or another subsection hospital. Risk standardized readmission rates are used to identify if hospitals have a high rate of readmissions (CMS, 2016). The most common measurement of readmission is all-cause 30-day readmission rates (Kansagara et al., 2011). However, there is a debate among researchers regarding the quality of empirical evidence for using 30 days as the timeframe for measuring hospital care quality (Joynt & Jha, 2012). Several researchers have argued that near-term readmissions (or when patients return to the hospital within 2 to 7 days) is a more valid measurement of the inpatient quality of care delivery (CMS, 2015b; Joynt & Jha, 2012). An alternative approach is to examine unplanned utilization of medical services such as unplanned readmission and/or unplanned return to the emergency department (ED; Van Walraven et al., 2011).

Although 30-day readmission rates are used by CMS as a quality of care indicator, the causes of hospital readmissions and unplanned returns to the ED are poorly understood and complex (Van Walraven et al., 2011). In the literature, there are three common approaches used by researchers to study readmissions: predicting readmission risk, describing preventable readmissions, and readmission reduction interventions.
**Prediction of readmission risk.** Developing models of prediction for readmission risk is key for (a) identifying factors associated with patients at high risk for poor transitions (nature of transitions and conditions); (b) identifying patients who could benefit from transition interventions (therapeutics); and (c) developing valid risk standardized readmission rates for hospital comparisons, public reporting, and CMS reimbursements (Kansagara et al., 2011). Hospital readmission risk is widely studied (Calvillo-King et al., 2013; Desai & Stevenson, 2012; Kansagara et al., 2011; Lichtman et al., 2010; Ross et al., 2008). Methods for studying the prediction of risk for hospital readmissions include retrospective analysis of administrative data; real time analysis of administrative data; and primary data collection using chart reviews, interviews, and surveys (Kansagara et al., 2011). However, the majority of readmission studies use retrospective analysis of administration data to examine clinical, demographic, and logistical risk factors for re-hospitalization (Greenwald & Jack, 2009; Kansagara et al., 2011).

Examining the content of prediction models can provide valuable information about potential variables (or the nature of the transition and transition conditions) that could impact a patient’s risk for readmission (Kansagara et al., 2011). Patient characteristics such as number of comorbidities, number of recent hospitalizations, and demographics are widely studied variables in prediction models (Kansagara et al., 2011). Broader social, environmental, and medical factors (such as access to care, social support, and functional status) have been found to contribute to readmission risk but are studied less frequently (Kansagara et al., 2011).

A large number of patient-level variables are associated with risk for readmission. Examples of hospitalization factors include taking high-risk medications (e.g., antibiotics, glucocorticoids, anticoagulants, narcotics, antiepileptic medications, antipsychotics, antidepressants, and hypoglycemic agents), polypharmacy (five or more medications), having more than six chronic conditions, prior hospitalization, post-hospitalization follow-up appointment time, and specific clinical conditions (e.g., advanced chronic obstructive pulmonary disease, diabetes, heart failure, stroke, and depression; Alper et al., 2013; Greenwald & Jack, 2009; Kansagara et al., 2011). Patient characteristics suspected to increase a patient’s risk for readmission include older age, lower socioeconomic status, limited social support, being unmarried/widowed, and low literacy (Alper et al., 2013; Greenwald & Jack,
Examples of commonly examined patient hospitalization factors and characteristics for readmission are listed in Table 2.

Overall, there appears to be no definitive consensus across the literature regarding the principal patient-level risk factors for hospital readmission. With the large number of patient-level variables being identified as risk factors for readmissions, using readmission as an indicator for inpatient quality of care has become controversial (Joynt & Jha, 2012; Kansagara et al., 2011). Interestingly, hospital- and system-level factors are rarely incorporated into prediction models of readmissions (Kansagara et al., 2011). The majority of prediction studies depend on data from large administrative data sets, which do not routinely assess these system factors. Therefore the role of the team processes, hospital, and system factors in predicting hospital readmission remains largely unknown (Kansagara et al., 2011).

**Preventable readmissions.** Estimates for the degree to which readmissions are preventable vary depending upon the population examined, definition of preventability used, and methods used to examine readmission (Greenwald & Jack, 2009; Van Walraven et al., 2011). Van Walraven et al. (2011) analyzed 34 quantitative research studies to examine and describe the preventability of hospital readmissions. Out of the 34 studies, the median proportion of readmissions deemed to be preventable was 27%; however, the studies varied greatly in the percentages of preventable readmissions and ranged from 5% to 79%. In part, the large variation in reported incidence can be attributed to the methods that researchers used to identify and define preventable readmissions (Van Walraven et al., 2011).

Identifying preventable readmissions is challenging because there is no established credible clinical criteria for determining if an admission is indeed avoidable. For example, according to Goldfield et al. (2008), readmission is considered to be potentially preventable if there is a reasonable expectation that one or more of the following actions could have prevented rehospitalization: (a) the provision of quality care in the initial hospitalization, (b) adequate discharge planning, (c) adequate post-hospitalization follow-up, or (d) improved coordination between inpatient and outpatient health care teams. Although Goldfield et al. (2008) provided a definition, deciding if the rehospitalization could have been prevented is still relatively subjective, as it requires clinical judgment.

Nonetheless, there is evidence to suggest that some readmissions are preventable (Alper et al., 2013), and ideas for improving inpatient care can come from examining the
reasons that patients return to the hospital. Potentially preventable variables identified in the literature include premature discharge, inadequate post-discharge support, insufficient follow-up, failed provider handoffs, complications following procedures, nonsocial infections, pressure ulcers, falls, medication issues (e.g., not filling prescription drugs, duplicated prescription, inadequate monitoring of side effects), lack of discussion about care goals, patient lack of awareness for whom to contact after discharge, and the failure to relay important information to outpatient health care professionals (Alper et al., 2013; Auerbach et al., 2016; Waring et al., 2016). These root causes of preventable readmissions illustrate lapses in the quality of care that could potentially be improved by more effective communication and coordination between the patient, family, inpatient healthcare team, and outpatient providers. Several interventions are available to help prevent hospital readmissions (Goncalves-Bradley, Lannin, Clemson, Cameron, & Shepperd, 2016; Grafft et al., 2010; Hansen, Williams, & Singer, 2011; Mueller, Sponsler, Kripalani, & Schnipper, 2012), and the literature addressing readmission reduction interventions will be discussed in the therapeutic section of the review.

Using readmission as an outcome. An advantage of using readmission as an outcome for the discharge to home transition is that rates can be generated from administrative data. A large number of records can be screened electronically and can be used as a basis for comparing hospitals (Goldfield et al., 2008). However, there are several barriers to using hospital readmissions (30-day all-cause readmissions and/or preventable readmissions) as a study outcome. First, the causes of hospital readmissions are poorly understood and difficult to untangle using administrative data sets (Auerbach et al., 2016). Using electronic medical records (EMRs) can be problematic for identifying patients who have been readmitted and/or if the readmission was preventable. Typically, EMRs are facility based and often do not interface with other facilities’ EMRs; therefore, rates can be underestimated if a patient is readmitted to a non-study facility. Additionally, national and administrative databases lack information about specific care processes, patients’ needs, or comorbidities that are most likely associated with readmissions (Auerbach et al., 2016). Second, studying all-cause 30-day readmission rates may not be an appropriate outcome measure for quality of care provided by the inpatient team (Joynt & Jha, 2012). All-cause readmission rates lack specificity, as the measure includes readmissions related to natural disease progression, and are subject to differences in patient case mix and individual patient-
level factors (Auerbach et al., 2016; Joynt & Jha, 2012). Last, there is lack of agreement in the field on what constitutes a preventable readmission as well as how commonly preventable readmissions occur. Although some readmissions are likely to be preventable, determining preventability requires provider(s) to review the case by using clinical judgment, thus making identification subjective and resource intensive.

**Post-hospitalization adverse events.** The second outcome of interest is adverse events (AEs) during and after hospital discharge. Most of the studies that examine AEs during the post-hospitalization period use the definitions provided by the IOM for medical errors, AEs, preventable AEs, and ameliorable AEs. Accordingly, a medical error is a “failure of planned action to be completed as intended…or the use of a wrong plan to achieve an aim” (Kohn, Corrigan, & Donaldson, 2000, p. 210), and AE is an injury caused by medical management rather than the underlying condition of the patient (Kohn et al., 2000). Preventable AEs are injuries that could have been avoided due to an error or flaw in the system (Forster et al., 2003). An ameliorable AE is one in which the injury severity could have been substantially reduced if different actions or procedures had been performed or followed (Forster et al., 2003). Lapses in discharge planning, patient assessment, and provider and patient communication are examples of potential causes of post-hospitalization AEs (Forster et al., 2003; Forster et al., 2004; Moore et al., 2003). AEs are frequently mentioned as an outcome of interest in the transition literature (Goncalves-Bradley et al., 2016; Hansen et al., 2011); however, only a few studies have examined patient safety in the post-hospitalization period (Tsilimingras & Bates, 2008).

**Prevalence of adverse events.** Few researchers have examined the overall prevalence of AEs during the post-hospitalization period (Forster et al., 2003; Forster et al., 2004; Moore et al., 2003; Mull et al., 2014). The prevalence of AEs during the post-hospitalization period is estimated to range from 17% (Forster et al., 2003) to 49% (Moore et al., 2003), depending upon the approach used in the study (Forster et al., 2003; Forster et al., 2004; Moore et al., 2003; Mull et al., 2014). Tellingly, only two studies have examined the frequency, preventability, and severity of AEs after hospitalization (Forster et al., 2003; Forster et al., 2004). One study identified the prevalence of medical errors related to discontinuity of care (Moore et al., 2003), and one study used Patient Safety Indicators to identify potential adverse events in the outpatient setting after discharge (Mull et al., 2014). Instead, the majority of the research focuses on describing the prevalence of specific adverse
events related to medications (Forster et al., 2005; Redmond, Grimes, McDonnell, Boland, Hughes & Fahey, 2013), lack of follow-up tests (Roy et al., 2005), inappropriate home dispositions (Wong & Miller, 2008), falls (Davenport et al., 2009), and surgical site infections (Petherick, 2006).

**Approaches for studying adverse events.** The approaches for studying AEs post-hospitalization are resource intensive. To identify AEs, Forster et al.’s (2003) single-site study and Forster et al.’s (2004) multiple-site study used a similar prospective study approach to create extensive case studies. Data were gathered from several sources including a review of inpatient and outpatient charts (handover notes, discharge summaries, previous orders, written instructions, emergency department and clinical notes, operative and procedural notes), laboratory results, and follow-up interviews with patients. Initially, all the case studies were then reviewed by a clinician to identify if a potential adverse patient outcome occurred for each patient. Then, if an adverse patient outcome was detected, an additional two to three physicians performed an independent review to determine if the potential adverse outcome was an AE, a preventable AE, and/or an ameliorable AE. Moore et al.’s (2003) study was less extensive than Forster et al.’s (2004); instead Moore et al. (2003) focused on identifying the prevalence of medical errors related to discontinuity of care as well as the impact of medical errors on post-hospitalization outcomes. AEs related to medication continuity, diagnostic workup, or test follow-up were identified using a retrospective review of the inpatient and primary care charts by two physicians (Moore et al., 2003). All three studies required intensive resources to identify potential AEs.

Another unique approach to examine potential AEs is described in Mull et al.’s (2014) study that used patient safety indicators to detect post-discharge AEs in the Veterans Health Administration (VHA). Patient Safety Indicators (PSIs) are standardized algorithms that use inpatient administrative data to flag cases with potentially preventable inpatient AEs attributable to hospital care. PSIs were developed to detect hospital AEs using changes in International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes during a patient’s stay. AHRQ has identified 18 hospital-level PSIs, including indicators such as central venous catheter-related bloodstream infection, decubitus ulcer, postoperative pulmonary embolism/deep vein thrombosis, postoperative sepsis, and postoperative wound dehiscence. Mull et al. (2014) adapted PSIs to detect potentially preventable AEs during the post-hospitalization period by connecting the VHA’s inpatient
and outpatient administrative data sets. Although Mull et al. (2014) was able to identify PSIs related to post-hospitalization using the large administrative data sets, the study was not able to clarify if the PSIs were in fact AEs, identify if the PSI was preventable, or describe the severity of harm experienced by the patient.

**Preventable adverse events.** There is limited research on the causes of adverse events in the post-hospitalization period. Forster et al. (2003) determined that systems problems contributed to all of the preventable and ameliorable AEs identified in that study. The most common systems problem identified was poor communication between the hospital caregivers and either the patient or the primary care physician (59% of the preventable and ameliorable AEs). Forster et al.’s (2003) analysis of AE causes identified four key areas of system improvements needed: (a) assessment and communication of unresolved problems at the time of discharge, (b) patient education regarding medications and other therapies, (c) monitoring of drug therapies after discharge, and (d) monitoring overall condition after discharge. These results are similar to retrospective analyses in the inpatient setting, which identified communication and teamwork issues to be among the more frequent contributory factors to AEs (i.e., 22-23% of reports; El-Dawalty et al., 2004; Pronovost et al, 2006; Suresh et al., 2004).

**Adverse events as outcomes.** A strength to studying AEs as an outcome is the potential to identify specific complications associated with hospital care (Mull et al., 2014). Understanding what AEs occur after hospitalization and identifying methods to detect AEs across transitions will be key to helping hospitals target quality improvement efforts. However, similar to hospital readmissions, the prevalence and predictors for AE are difficult to capture due to the separation between inpatient/outpatient EMRs, low instances of occurrence, potential subjective bias for determining preventability of an AE, and the intensive resources needed (Auerbach et al., 2016; Forster et al., 2003; Forster et al., 2004).

**Patient-centered outcomes.** An alternative approach to examining the outcomes of discharge transitions is to focus on patient experiences (Frank, Basch, & Selby, 2014). Patient-centered outcomes provide a valuable yet underutilized way to examine patients’ patterns of responses to hospital discharge. The IOM includes patient-centered care as one of the main objectives for improving healthcare in the 21st century (IOM, 2001). Patient-centered care is defined as “providing care that is respectful of and responsive to individual’s patients’ preferences, needs, and values, and ensuring that patient values guide all clinical
decisions” (IOM, 2001, p. 6). Patient-centered care involves knowing the patient as a person and working with other healthcare providers as a team to engage the patient as an active participant in his or her care (Epstein, Fiscella, Lesser, & Stange, 2010). Measuring patient-centered outcomes focuses on capturing the quality of healthcare received from the patient’s perspective and the outcomes that are meaningful and important to patients and caregivers (Frank et al., 2014). The National Cancer Institute outlines six measurable aspects of patient-centered care: fostering healing relationships, exchanging information, responding to emotions, managing uncertainty, making decisions, and enabling self-management (Epstein & Street, 2007; Frank et al., 2012). Additionally, patient-centered care has been shown to improve other important outcomes such as patient satisfaction, well-being, empowerment, adherence to medications, self-management, and overall cost savings (Rathert, Wyrwich, & Boren, 2012).

Transition theory in conjunction with the concept of patient-centered care can be used as a lens to identify what might constitute a healthy transition from the patient’s perspective as well as a way to evaluate quality of care delivered by the healthcare team. Transition theory identifies patients’ response patterns (process and outcome indicators), which comprise the patient’s feelings of confidence and competence as well as mastery of skills for a healthy transition. There are several patient-centered outcomes that can be aligned with the transition theory to examine the hospital-to-home transition, including patient readiness for hospital discharge (RHD; Weiss & Piacentine, 2006) and the quality of transition home (Coleman, Parry, Chalmers, & Min, 2006).

**Patient readiness for hospital discharge.** Patients, families, and providers have identified patient RHD as an essential part of the discharge process (Foust, 2007; Greysen et al., 2012; Heine, Koch, & Goldie, 2004; Hesselink et al., 2013; Lerret, 2009). Weiss and Piacentine (2006) defined RHD as “a judgment or perception regarding the patient’s immediate state and perceived abilities that relate to managing care needs in the home environment” (p. 5). A patient’s RHD can be assessed by the patient, family members, and providers (e.g., nurse, care coordinator, physician, social worker). RHD can be used as an assessment tool, process of care indicator, patient outcome, and/or a predictor for post-hospitalization outcomes (Weiss & Piacentine, 2006).
Assessing RHD. RHD can be assessed from multiple perspectives, but is commonly conceptualized from the providers’ perspective. The patient is considered ready to be discharged when he or she is medically stable enough to no longer need acute care (Alper et al., 2013; Weiss & Piacentine, 2006). RHD has been traditionally measured using criterion factor assessments (Barnes, 2000), single-item yes/no format (Bernstein et al., 2002), or ordinal Likert-scaled responses to understand how prepared the patient is for discharge (Bull, 2000). However, from a patient-centered and transition theory perspective, being ready for hospital discharge involves more than being medically stable. It includes the patient’s feeling of preparedness and confidence, having the ability to care for himself or herself, and the desire to leave the hospital and transition to home (Weiss et al., 2008). Weiss and Piacentine (2006) identified that RHD as a multidimensional construct incorporates not only the patient’s personal status (physical-emotional state) but also other important attributes such as the patient’s knowledge, coping ability, and expected support. To encompass the multidimensional nature of RHD, Weiss and Paicentine (2006) developed the patient Readiness for Hospital Discharge Scale (RHDS), Nurse-Readiness for Hospital Discharge Scale (RN-RHDS), and MD-Readiness for Hospital Discharge Scale (MD-RHDS).

The RHD scales (RHDS, RN-RHDS, MD-RHDS) are the most commonly used measurement tools to examine RHD from a patient-centered standpoint (Bobay, Jefofke, Weiss, Yakusteva, 2010; Weiss & Piacentine, 2006). RHDS is completed on the day of hospital discharge and assesses the following critical dimensions of discharge readiness: personal status, knowledge, coping ability, and expected support (Weiss et al., 2014). In the Personal Status subscale, respondents are asked to report their physical-emotional condition on the day of hospital discharge. The Knowledge subscale asks about the amount of information the patient received about self-care after discharge. The Coping Ability subscale measures the patient’s perceived ability to cope with medical and personal care at home. The Expected Support subscale asks about the expected availability of emotional and personal assistance after hospital discharge. Likewise, the provider scales (RN-RHDS, MD-RHDS) are parallel forms to the patient’s RHDS. Psychometric tests have shown that RHDS and RN-RHDS, and to a lesser extent MD-RHDS, are reliable and valid scales that can be used with a range of patient conditions such as age, diagnosis, ethnicity, and language (Bobay,
Using RHD as an outcome. RHD is associated with post-hospitalization coping (Weiss et al., 2007; Weiss et al., 2008; Weiss & Lokken, 2009) as well as utilization of health services including hospital readmissions and ED visits (Bobay et al., 2010; Weiss et al., 2007). Examples of variables that are positively correlated with increased RHD include living with others, discharge education (amount of content received and nurses’ skill in teaching delivery), care coordination, social support, and health literacy (Bobay et al., 2010; Wallace, Perkhounkova, Bohr, & Chung, 2016; Weiss et al., 2007). Compared to single-item questions regarding RHD, the patient RHDS is a more specific measure that has higher sensitivity to predicting post-discharge outcomes (Bobay et al., 2010). Weiss et al. (2014) found that lower RN-RHDS scores were associated with a six- to nine-fold increase in risk of readmission (Weiss et al., 2014). However, some studies have not found an association between patients’ reported RHD and hospital readmissions (Weiss et al., 2014; Weiss, Yakusheva, & Bobay, 2010).

In spite of the mixed evidence for the relationship between RHD and post-hospitalization utilization of health services, RHD still provides a useful patient-centered outcome for the immediate hospitalization period. Outcomes like hospital readmissions and AEs focus on capturing unhealthy transitions, whereas Weiss’s RHD scales can capture additional essential components of a healthy transition and be used as an immediate outcome measure of a healthy transition. Additionally, assessing a patient’s RHD from the patient’s and provider’s perspective could also serve as a process outcome. Weiss et al.’s (2014) study identified that nurses and patients disagreed on how ready a patient was for hospital discharge. Developing a shared understanding of the patient’s needs, preferences, and values is an essential aspect to providing truly patient-centered care (Epstein et al., 2010). Because it is important in patient-centered care that the patient’s and provider’s perceptions are aligned, examining the level of concordance/discordance between providers and patients can serve as a potential process indicator for the quality of patient-centered care delivered. Yet rarely is this shared understanding between patients and provider(s) examined or measured in the literature.
Quality of transition hospital to home. A second patient-centered outcome for hospital discharge is the quality of transition home. A major task for the inpatient healthcare team is to work together to prepare the patient for a healthy transition from the hospital to home; therefore, the patient is in a unique position to provide an assessment of the team’s performance. There are a few measures available to test the quality of transitions from the patient’s perspective (Graumlich, Novotny, & Aldag, 2008; Hansen et al., 2010), but the Care Transitions Measure (CTM) is the most widely used (Coleman et al., 2005; Parry et al., 2008).

Assessing quality of transition home. The CTM is administered during the 30-day post-discharge period and was developed to assess the extent to which hospital staff accomplished essential care processes in preparing patients for discharge (Coleman et al., 2015). The CTM content focuses on what actions the hospital staff completed to prepare the patient for discharge (Coleman et al., 2015). The CTM includes four critical dimensions of quality discharge: (a) critical understanding of responsibilities, medications, discharge instructions; (b) respect for individual differences: did the patient and healthcare team agree on needs and goals; (c) preparation for self-management: understanding of the information needed for self-care, such as signs and symptoms to monitor, as well as what makes their condition worse/better; and (d) written care plan: presence of a care plan and list of appointments (Coleman et al., 2005). These critical dimensions of quality discharge match the Medicare Conditions of Participation mandates, and the CTM is recommended by AHRQ and The Joint Commission as a patient-centered outcome for transitions (Coleman et al., 2015).

The National Quality Forum endorses the CTM, and the CTM-3 is included in the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS; Parry et al., 2008). Psychometric tests have shown that the CTM-15 and shorter version (CTM-3) are reliable and valid scales that can be used with a range of patient conditions (e.g., age, diagnosis, ethnicity, and language; Anatchkova et al., 2014; Bakshi et al., 2012; Parry et al., 2008). In addition to being a patient-centered outcome, the CTM has been able to discriminate between patients discharged from the hospital who did or did not experience a subsequent emergency visit or rehospitalization as well as health care facilities with differing levels of commitment to care coordination (Coleman et al., 2005).
Using patient-centered outcomes. Patient readiness and preparedness for self-management at home are key for determining the appropriate timing of and activities involved with the hospital discharge process (e.g., education, arranging community-based resources; Weiss et al., 2015). While 30-day hospital readmission has been used as an outcome of inpatient healthcare team performance (Kripalani et al., 2013), a more comprehensive and patient-centered measure includes both patient readiness and preparedness for discharge, as these measures can account for not only readmission risk but also factors such as the patient’s ability to recover to his or her preadmission state (Coleman et al., 2005; Weiss & Piacentine, 2006). A strength of this approach includes the fact that patient readiness for discharge provides a more proximate measure of inpatient healthcare team performance, acting as a process measure for team actions during the hospital stay (Coleman et al., 2005), whereas other measures of discharge are less direct and prone to influence by uncontrollable variables (Goodman et al., 2013; Van Walraven et al., 2011).

Review of Therapeutics

A major component of transition theory is the role of therapeutics (or interventions) that the healthcare team can use to facilitate the transition experience. Schumacher and Meleis (1994) identified three nursing interventions for transitions: assessing readiness for transition, preparation for transition, and support supplementation. Although these interventions are aimed at the nursing profession, all three require interdisciplinary action for a transition such as discharging from the hospital to home. During the past decade, a wide range of strategies to facilitate healthy transitions home and reduce unplanned hospitalization have been implemented and empirically tested (Goncalves-Bradley et al., 2016). Many of these interventions can be categorized as assessments, inpatient preparation for discharge, outpatient role supplementation, and bundled transitional care approaches (see Table 2).

Assessment interventions. Assessment of patient readiness for transition is used to identify patients’ needs, preferences, and feasibility of post-discharge plans as well as to identify patients who are at increased risk for poor post-management of care, AEs, and unplanned readmissions (Weiss et al., 2015). Risk-assessments, including functional or cognitive status, social support, language needs, and cultural factors, are often taken upon admission (Weiss et al., 2015), whereas knowledge deficits and equipment needs are completed closer to expected discharge (Weiss et al., 2015). Schumacher and Meleis (1994)
described the therapeutic of readiness assessment as a “multidisciplinary endeavor” that “requires a comprehensive understanding of the client” (Schumacher & Meleis, 1994, p. 46). The importance of assessing the patient’s readiness for hospital discharge is a common theme in discharge process theoretical frameworks (Table 2; Congdon, 1994; Pethybridge, 2004; Potthoff et al., 1997; Weiss et al., 2007; Weiss et al., 2015) and discharge planning interventions (Coleman et al., 2006; Hansen et al., 2010; Henriksen et al., 2005; Naylor et al., 2010).

Assessment tools to examine patient readiness for hospital discharge include RHDS (Weiss & Piacentine, 2006), RN-RHDS (Weiss et al., 2014), MD-RHDS, PREPARED patient questionnaire (Graumlich et al., 2008), IDEAL Discharge Planning Checklist (AHRQ, 2014), Early Screen for Discharge Planning (Bowles, Holland, & Potashnik, 2012), and BOOST 8Ps (Hansen et al., 2010). Inadequate assessment is linked to delays in hospital discharge, inappropriate referrals to post-acute care services, unmet needs after discharge, and readmissions (Bowles et al., 2012; AHRQ, 2014; Weiss et al., 2010). Interestingly, the available assessment tools do not assess the patient from an interdisciplinary perspective and instead focus on one provider’s perspective or the patient’s perspective.

It is widely recognized that to coordinate care, providers need a shared understanding of the patient’s needs, but there is little literature reporting research examining the level of shared understanding or concordance among team members regarding important team tasks like assessment for RHD. To date, the Weiss RHD scales have only been used to examine the nurses’, physicians’, and patient’s perceptions as well as only examining the discordance between the nurse and the patient (Wallace et al., 2016; Weiss et al., 2006; Weiss et al., 2014). However, the level of concordance among different healthcare professionals regarding the patient’s RHD has not been examined or compared to the patient’s self-reported RHD.

**Interventions to Prepare Patients for Discharge.** A second therapeutic is preparing the patient for the transition through planning, education, and coordination of resources (Schumacher & Meleis, 1994). Hospital discharge preparation encompasses “the multiple care processes whereby the patient, family, and receiving care providers become ready for the discharge and management needs of health needs in a subsequent venue” (Weiss et al., 2015, p. 607). Preparation interventions by the inpatient team are aimed at discharge planning, coordination, and teaching (Weiss et al., 2015). To prepare patients for
self-management at home, various inpatient preparation strategies have been implemented and studied (in isolation and in bundles), including medication reconciliation (Mueller, Sponsler, Kripalani, & Schnipper, 2012), patient-centered discharge instructions and transition records (Hansen et al., 2011), inpatient physician to primary care physician sign-off (Hesselink et al., 2013), outpatient follow-up arrangement (Grafft et al., 2010), and patient education (Kripalani et al., 2007).

Many of these interventions have been shown to have positive effects on patient care (Hesselink et al., 2013). However, several systematic literature reviews have examined the link between pre-discharge preparation interventions and post-discharge outcomes, yet no single intervention implemented alone has consistently been associated with reduced risk for 30-day readmissions (Goncalves-Bradley et al., 2016; Grafft et al., 2010; Hansen et al., 2011; Mueller et al., 2012). Additionally, effective interventions are more complex and focus on supporting patients’ capacity for self-care during their transition from the hospital to home. There is some evidence that personalized discharge plans bring about a small reduction in hospital length of stay and readmission rates for elderly patients admitted to the hospital with a medical condition (Goncalves-Bradley et al., 2016).

Role supplementation interventions. The third therapeutic is role supplementation, which involves working with the patients to clarify their roles in having healthy transitions and providing needed resources if the patient is at risk for inadequate coping (Schumacher & Meleis, 1994). Role supplement interventions that are used to help facilitate the discharge transition process are often implemented in the post-hospitalization phase. Examples of such therapeutics might include post-discharge phone calls (Bahr et al., 2014), home health nurse visits (Hansen et al., 2011), and telehealth monitoring (Wakefield et al., 2009). Post-discharge phone calls typically involve an inpatient nurse calling the patient 24 to 48 hours after hospital discharge to monitor progress and clarify questions once the patient is at home (Bahr et al., 2014). However, the evidence is inconclusive for the use of post-discharge phone calls to decrease readmissions and ED use, as well as increase patient satisfaction, schedule follow-up, and physical emotional well-being (Hesselink et al., 2013). Both home health visits and telehealth monitoring have been shown to be effective in reducing hospital readmissions in high-risk populations; however, these are often expensive and resource intensive (Hansen et al., 2011; Louis, Turner, Gretton, Baksh, & Cleland, 2003).
**Transitional care bundles and models.** The last set of common interventions in the literature is hospital-initiated transitional care interventions and/or discharge bundles, which contain a mixture of the assessment, preparation, and role supplementation therapeutics. Transitional care includes a broad range of time-limited services and is designed to ensure continuity of care, avoid preventable poor outcomes, and promote the safe and timely transfer of patients from one setting to another (Naylor et al., 2011).

Several evidence-based transitions of care practice models have been developed to improve patient outcomes post-hospitalization. Examples of transition of care models include the Transitional Care Model (TCM; Naylor et al., 2010), Better Outcomes for Older Adults through Safe Transitions (BOOST; Hansen et al., 2010), Project RED (Re-Engineered Discharge; Henriksen et al., 2005), and Care Transitions Measure (CTM; Coleman et al., 2006). Although each transition of care model includes process bundles to improve patient care, several commonalities exist among them (The Joint Commission, 2015): interprofessional communication, collaboration, and coordination (including the patient/caregiver) from admission through the transition; comprehensive planning and risk assessment throughout hospital stay; standardized transition plans; and timely follow-up, support, and coordination after the patient leaves a care setting.

These care models have been shown to reduce hospital readmission and improve patient-centered care; however, there is mixed evidence on the overall effectiveness as well as the generalizability of the interventions to other settings (Hansen et al., 2013; Mitchell et al., 2017; Naylor et al., 2011). In addition, many of these models of care are resource intensive, require extensive staff training, include additional staff members, and are not being widely implemented (Mitchell et al., 2017; Naylor et al., 2011). For example, initial studies implementing the BOOST bundle found a reduction in readmissions (Hansen et al., 2010); however, when expanded to multiple sites, only minimal reductions in 30-day, all-cause readmissions were measured (Hansen et al., 2014). Interestingly, Hansen et al. (2014) initially tried to implement BOOST in 30 hospitals; however, sustainability of the program was poor with only 11 hospitals still using BOOST after 2 years. Hansen et al. (2014) suggested that the effectiveness of BOOST might have been a result of variable implementation. A central component of BOOST is improving patient-centered discharges through team development and coordination (i.e., delineating providers’ roles in the discharge process, creating a care plan, and providing patient-centered education), but no process measures related to
teamwork were evaluated (Hansen et al., 2014). Nevertheless, these transition of care models share many commonalities with the discharge process theoretical frameworks and provide evidence for the importance of the interprofessional care team during the discharge process.

Methods to examine the discharge process from an interprofessional perspective are also needed to evaluate the effectiveness of transitional care model interventions (Greysen et al., 2012; McDonald et al., 2007; Salas & Frush, 2012). Assessing teamwork is critical because properties of teamwork (e.g., roles, communication, shared goals, situational awareness, backup behavior) have been identified as important components of safe, patient-centered discharges (AHRQ, 2012). Although interprofessional teamwork, collaboration, and communication are identified as essential components of the bundled interventions previously described (The Joint Commission, 2015), the published research reports do not include evaluation of teamwork with implementation. Without measuring teamwork, it is possible that interventions lack intervention fidelity and are not actually increasing teamwork during the discharge process.

Other studies identifying different healthcare professionals have divergent views on teamwork (McCaffrey et al., 2010; Tang, Chan, Zhou, & Liaw, 2013; Thomas, Sexton, & Helmreich, 2003). Thomas et al. (2003) found that when asked about the quality of teamwork on the unit, physicians consistently rated higher teamwork quality than nurses rated the quality of the same teams. Additionally, Nosbusch et al.’s (2011) integrative review on hospital discharge education discusses how nurses feel “invisible” in the discharge planning process, whereas Hudson et al.’s (2014) literature review identified power differentials between physicians and other team members as a major challenge to determining patient’s discharge readiness. Several qualitative studies identified that the lack of shared understanding of a patient’s social history and the patient’s care plan can lead to inaccurate assumptions about the patient’s situation and can lead to poorer transitional care outcomes (Ashbrook et al., 2013; Canary & Wilkins, 2017; Greysen et al., 2012; Mitchell et al., 2017; Waring et al., 2016). The divergence in the perceptions of teamwork and taskwork is suggested to be an indication of poor performing teams as well as a barrier to implementing change in practice (McCaffrey et al., 2010; Mitchell et al., 2017; Tang et al., 2013; Thomas et al., 2003). Considering the inconsistency in both effectiveness and implementation of transitional care model bundles like BOOST, examining the quality of
teamwork during the discharge process is a key component of intervention fidelity and is a logical next step for improving the effectiveness of team-based transition interventions (Goncalves-Bradley et al., 2016).

**Gaps in the Literature**

It is widely recognized that the inpatient healthcare team plays a vital role in preparing patients for self-management at home. Due to the complexity of coordinating care, AHRQ (2014) recommends a team-based approach for high-risk transition points like hospital discharge. Qualitative studies investigating the sources of unmet needs indicate a lack of discharge preparation and planning by the healthcare team (Coleman et al., 2005; Coleman et al., 2013; Corser, 2006; Fuji et al., 2013; Hesselink et al., 2013; Horwitz et al., 2013; Waring et al., 2015). Studies have identified that both collaboration among the healthcare team and communication between hospital providers and/or the patient are among the most frequent contributing factors to preventable readmissions and post-discharge adverse events (Forster et al., 2003; Forster et al., 2004). Likewise, qualitative studies examining barriers to delivering patient-centered discharges from the perspective of providers identify that providers lack a shared understanding of the discharge process and patient needs (Ashbrook et al., 2013; Greysen et al., 2012; McDonald et al., 2007; Waring et al., 2016).

This study addresses a number of gaps in the existing literature. Although teamwork has been identified as a contributor to the quality of hospital discharge, the role of specific team process is not readily examined. Hospital discharge involves multiple care providers, but current studies do not examine the discharge process from an interprofessional standpoint (AHRQ, 2014; Ashbrook et al., 2013; Goodman et al., 2013; Waring et al., 2016). Studies examining the discharge process do not include all key healthcare team providers, patients, and their shared role and task knowledge (AHRQ, 2014; Ashbrook et al., 2013; Goodman et al., 2013; Waring et al., 2016). Thus, it is possible researchers and care providers do not have a full understanding of provider roles in the discharge team and the entire discharge task (Pinelli et al., 2015). Extant literature also focuses on individual perceptions, not on the performance of the team as it relates to their shared knowledge of the discharge teamwork and taskwork (Ashbrook et al., 2013; Goodman et al., 2013; Nosbusch et al., 2011; Waring et al., 2016). Research suggests that a major contributor to coordination failures at time of hospital discharge is that preparing patients for discharge requires multiple
tasks that cross professional boundaries (Waring et al., 2016). Without an examination of the perceptions of the entire team, it is possible that team-based interventions to improve patient transitions to home (such as huddles, checklists, interprofessional care plans, etc.) may lack fidelity.

This study begins to address these gaps in the literature by developing methods to determine how healthcare providers share knowledge of team and tasks, which will allow for the development of discharge interventions to better prepare patients for safe self-management at home.

A Team Approach

To address these gaps, there is a need to look at the problems related to the discharge process from a team perspective. Kozlowski and Bell (2003) defined teams as: collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity (p. 334).

On the day of hospital discharge, there are several different healthcare professionals, including the bedside nurse, social worker, physician, and discharge coordinator, who work together as a team with the goal of preparing patients for a safe transition from the hospital to home (Waring et al., 2016). Due to the complexity of coordinating care, organizations such as the AHRQ, The Joint Commission, and the Institute for Healthcare Improvement call for examining the discharge process using an interprofessional, team-based approach (AHRQ, 2014; The Joint Commission, 2015).

Input-Process-Output Model

In this study, the input-process-output model is used as a conceptual framework to examine how the inpatient healthcare team influences patient post-hospitalization outcomes. McGrath’s (1964) input-process-output (IPO) model has been widely used as a descriptive framework to understand team effectiveness and performance for over 50 years. The IPO framework is particularly useful to understand the important question of why some teams are more effective than others (McGrath, 1964). This model describes the relationship between three dimensions of team performance: inputs, processes, and outputs (Figure 3).
The linear nature of McGrath’s IPO model suggests that the variations in team performance can be explained by breaking down the task into inputs, which undergo a series of team interaction processes by the team and result in the team’s performance output. Inputs describe the antecedent factors that enable and constrain the team members’ actions (McGrath, 1964). Inputs can occur on various levels, including individual (e.g., personalities, confidence, and education level), group (e.g., task structure, leadership), and environmental (e.g., organizational design features; Mathieu, Maynard, Rapp, & Gilson, 2008). The process dimension describes members’ interactions directed toward task accomplishment and how team inputs are transformed into the outcomes. Examples of team processes include communication, shared goals, and backup behaviors (Mathieu et al., 2008). Last, outputs are the result of the team’s activities and include their performance and members’ affective reactions (Mathieu et al., 2008).

Figure 3. McGrath’s (1964) input-process-output (IPO) model

Examining team processes provides a better understanding of how the healthcare team coordinates care when discharging a patient and aids in developing specific team-based interventions that improve patient care. Historically, team processes are categorized as either teamwork or taskwork, where teamwork describes the interaction between team members and taskwork describes the functions that the individual must perform to accomplish the team’s task (Mathieu et al., 2008).

A critical task for inpatient healthcare teams is to work together and ready the patient for self–management at home and to prevent unplanned utilization of medical services. A review of the discharge and transition literature identified two potentially important aspects of this task: (a) the team’s interactions during the discharge process and (b) the team’s ability to assess the patient’s level of readiness. I hypothesize that the discharge team’s shared understanding of the patient’s readiness for discharge and team members’ roles/interactions
impact the team’s capacity to provide appropriate timing of, and activities involved with, the discharge process. With the growing policy focus on improving the quality of transitions to prevent readmissions, there is a need to identify how the team impacts post-discharge outcomes. Shared mental models provide a useful way of examining how teams cognitively coordinate the complex task of readying patients for self-management at home.

**Shared Mental Model Theory**

The following section provides background related to team SMMs. The review begins with historical background of the SMM concept, and then focuses on describing what is known about SMM content, properties, and outcomes in both organizational psychology and healthcare systems literature.

**Mental models.** The concept of SMMs is rooted in individual-level concepts of cognitive psychology, including mental models (Johnson-Laird, 1983), schemas (Anderson, 1980), and cognitive maps (Weick & Bougon, 1986). These terms are all used to explain the process by which individuals cognitively filter and organize information to understand the world (McComb & Simpson, 2014). The theory of mental models suggests that humans construct working cognitive models that continuously form links of association among current perceptions of the environment, previous knowledge, and past experiences (Johnson-Laird, 1983). Individuals use mental models to filter information so that they are able to describe the basic function of systems, understand their role within the systems, and form explanations as well as predictions of the systems’ current and future states (DeChurch & Mesmer-Magnus, 2010; Rouse & Morris, 1986).

Analyzing an individual’s mental models can provide critical insight into the cognitive thought processes that contribute to performing tasks. For example, a nurse might have a mental model for the task of administering medication. The nurse’s mental model might include knowledge of why the medication is needed, where the medication is physically located, steps of administration, and symptoms to monitor post-administration. Techniques such as questionnaires (Heisler et al., 2003), cognitive task analysis (Johnson & Turley, 2006), and concept mapping and process mapping (Huang et al., 2012) can be used to examine the content of mental models. Practitioners, educators, and researchers have used these techniques to identify best practices, check comprehension, redesign processes, and improve provider performance (Heisler et al., 2003; Johnson & Turley, 2006; McComb & Simpson, 2014).
However, in work environments that require teams of individuals to complete complex tasks, investigating one person’s individual mental model will only provide information from one person’s perspective. For example, during a surgery, it is likely that the circulator nurse, surgical technician, anesthesiologist, and surgeon have different, but similar, mental models about the operation. Therefore, when examining cognition related to team-dependent tasks, it is necessary to examine the collective knowledge held by the team (Cooke et al., 2000).

Shared mental models. Collective knowledge held by the team comprises team SMMs. Cannon-Bowers et al. (1990) were the first to suggest that individuals not only form and use mental models, but that teams actively share mental models. The concept of team SMMs was developed to explain the performance of military teams demonstrating the ability to coordinate actions without overt communication (Cannon-Bowers et al., 1990; DeChurch & Mesmer-Magnus, 2010). Teams that are “on the same page” or “act in the same movie” are said to have SMMs (Brindley & Reynolds, 2011, p. 156; Leonard, Graham, & Bonacum, 2004). An SMM exists as a team-level property and is defined as the team members’ shared understanding and organized knowledge of key elements needed for teams to perform effectively (see Figure 4; Cooke et al., 2000). Several disciplines have found links between SMMs and team performance, including industrial/organizational psychology, information sciences and technology, engineering, healthcare, human factors, ergonomics, and sports (Mohammed, Tesler, & Hamilton, 2012).
**SMM content.** Teams can hold multiple SMMs at once that contain different types (content) of shared knowledge (Cannon et al., 1993). Most research focuses on two major content domains: task-focused mental models and team-focused mental models. Taskwork SMMs contain knowledge of the task situation (current status, expectations, what needs to be done), whereas Teamwork SMMs contain knowledge of the team members (expertise, preferences, strengths/weaknesses) and team interactions (roles/responsibilities, communication patterns, levels of support; Cooke et al., 2000). When the Taskwork and Teamwork SMMs are accurate and appropriately apportioned among members, team members can (a) describe what is happening and why; (b) create expectations for the team members’ roles and tasks; and (c) formulate predictions for what might come next, resulting in better coordination of action and adaptation of behavior to the demands of the task and other team members (Cannon-Bowers et al., 1990; Miller et al., 2009; Millward & Jefferies, 2001). Thus it is important to examine both Teamwork and Taskwork SMMs.

The knowledge content of Teamwork SMMs and Taskwork SMMs is specific to the context and type of team (Cannon-Bowers et al., 1993; Mohammed et al., 2010). However, in the literature there is no agreed method for identifying the contents of an SMM. Various approaches, such as identifying/refining previously used tools or performing cognitive interviews, can be used to identify potential appropriate content of SMM (Langan-Fox, Code, & Langfield-Smith, 2008; Mohammed et al., 2010). One approach to identifying appropriate Taskwork SMM content, as will be used in this study, is to review the literature to identify key components of the task (Mohammed et al., 2010). An advantage of reviewing the literature to identify appropriate SMM content is potentially being able to use pre-existing tools that are psychometrically tested (Mohammed et al., 2010).

Evidence supports that SMMs in healthcare teams are built on individual patient situations, incorporating the interrelationships among healthcare team members (Teamwork SMM) and specific processes to care for patients (Taskwork SMM) (Burtscher & Manser, 2012; Kalisch, 2009; McComb et al., 2012; Westli et al., 2010). Examples of the SMMs studied in healthcare include surgical team instrument preferences (Gillespie et al., 2010), communicating vital assessments (Miller et al., 2009), patient condition and care plans (Miller et al., 2009), and plans for changing patient conditions (McComb et al., 2012; Miller et al., 2009). However, no study was located examining the content of taskwork or teamwork for preparing the patient for safe self-management at home.
**SMM properties.** The SMM properties of convergence and accuracy are linked to team performance in other fields but have not been readily examined in healthcare teams (Burtscher et al., 2012; Johnson & Turley, 2006).

*Convergence.* Convergence is the degree of overlap (or agreement) among IMMs of the team members (Lim & Klein, 2006). The degree of convergence of IMMs comprising SMMs is also linked to team performance (Lim & Klein, 2006). Additional terms for convergence in the healthcare literature include substantial agreement (Burke, Salas, Wilson-Donnelly, & Priest; 2004; Burtscher & Manser, 2012), common understanding (Leonard et al., 2004; Miller, Riley, & Davis, 2009), same standpoint (Leonard et al., 2004), consensus understanding (Salas, Wilson, Murphy, King, & Salisbury, 2008), same understanding (Miller et al., 2009), mutual conceptualization (Kalisch, 2009), and overlapping understanding (Millward & Jeffries, 2001). The degree of a team’s SMM convergence is important because convergence captures the level of understanding between the healthcare team members and thus has implications for patient safety and patient-centered care.

During high-risk points of care that require a shared understanding of the patient’s situation among the healthcare team, it is believed that teams need to have a convergent SMM of teamwork and taskwork to safely care for patients (Burtscher & Manser, 2012; Johnson & Turley, 2006). However, the level of knowledge overlap needed for effective teamwork in healthcare is unknown (Cooke et al., 2000; Millward & Jefferies, 2001). Although an SMM can increase team performance, healthcare professionals are highly specialized. Therefore, there is likely a point at which too much convergence among IMMs could result in “group think” and thus limit the team’s adaptability (Mohammed et al., 2012; Westli, Johnsen, Eid, Rasten, & Brattebo, 2010). Cutrer and Thammasitboon (2012) suggested that too much IMM overlap could prevent some professions from incorporating their knowledge and perspectives into the team SMM, resulting in a limited and inaccurate team understanding of the patient situation. Conversely, if a team does not hold a common understanding of relevant information, they function under divergent IMMs and are unable to coordinate patient care (Mohammed et al., 2012).

Additionally, the degree of convergence among the healthcare team members has implications for coordinating patient-centered care. A critical component of patient-centered interactions is having a shared understanding (convergent SMM) of the patient’s values, needs, and preferences to work with the patient to develop a plan of care (Epstein et al.,
Lyndon et al. (2012) discussed that nurses and physicians in practice may be unaware
that they have divergent views related to patient diagnosis, patient plan of care, and their
professional roles in the team. Additionally, Thomas et al.’s (2003) cross-sectional survey
study of 90 physicians and 230 nurses examined the attitudes of providers towards teamwork
and communication. Thomas et al. (2003) found a lack of convergence between nurses and
physicians: 33% of the nurses rated the quality of communication and collaboration as high
compared to 73% of the physicians surveyed. Being unaware of differences in clinical
perceptions creates a gap in understanding among team members that inhibits delivering
patient-centered care (Epstein et al., 2010; Lyndon et al., 2012; O’Leary et al., 2010).
However, few studies have examined the level of convergence within healthcare teams
(Wallace et al., 2016).

Accuracy. Accuracy represents the correctness of the team’s SMM compared to what
is actually going on (Cannon-Bowers et al., 1993; Mohammed et al., 2010). For example, if
there is an available “gold standard” or an expert on the task, the team’s SMM accuracy
indicates the degree to which the team members’ SMM is consistent with the standard
(Burtscher & Manser, 2012). Accurate SMMs are positively related to team performance
(Edwards, Day, Arthur, & Bell, 2006). Additionally, accurate and similar SMMs can help
reduce the need of teams to communicate and coordinate together, as having a shared
understanding of the steps involved with the task and who does what decreases the need for
lengthy discussions (Burtscher & Manser, 2012). SMM accuracy has implications for
examining whether care is truly patient centered by providing a method of comparing the
team perceptions to patient perceptions (Epstein et al., 2010; McComb & Simpson, 2014).
Measuring SMM accuracy could be helpful for assessing patients’ needs, identifying
patients/teams understanding of the situation, and providing a process outcome for how
well the team provided patient-centered care.

SMMs outcomes. SMMs were originally developed to explain differences in
performances between teams (Cannon-Bowers et al., 1990; Mohammed et al., 2010). Studies
from multiple disciplines have established a positive relationship between SMM convergence
and team performance for both Teamwork and Taskwork SMMs (Cooke et al., 2000;
Edwards et al., 2006; Lim & Klein, 2006; Mathieu, Heffner, Goodwin, Salas, & Cannon-
Bowers, 2000; Mathieu, Heffner, Goodwin, Cannon-Bowers, & Salas, 2005; Mohammed et
al., 2010; Rentsch & Klimoski, 2001; Smith-Jentsch, Mathieu, & Kraiger, 2005). The
definition of team performance depends upon the team type, context, and task (Mohammed et al., 2010). Examples of SMM outcomes include client satisfaction (Rentsch & Klimoski, 2001), military assessments (Lim & Klein, 2006), decision quality (Kellermanns, Floyd, Pearson, & Spencer, 2008), and season winning percentage in baseball (Webber, Chen, Payne, Marsh, & Zaccaro, 2000). In studies that examined both teamwork and taskwork as separate content areas, the convergence of Taskwork SMMs had a stronger effect on team performance compared with Teamwork SMMs (Cooke et al., 2000; Lim & Klein, 2005; Mathieu et al., 2005). In addition to team performances, SMMs are associated with team processes. Examples of team processes associated with more convergent SMMs include coordination (Marks et al., 2002), effective communication (Marks et al., 2000), and back-up behavior (supporting co-workers) quality (Marks et al., 2002).

**Outcomes of SMMs in healthcare.** SMMs are a team coordinating mechanism and may be vital to understanding and improving healthcare team performance (Baker, Gustafson, Beaubien, Salas, & Barach, 2003; Burke et al., 2004; McComb & Simpson, 2013; Millward & Jeffries, 2001). The consequences of SMMs are closely linked to improving healthcare teamwork and patient safety; however, these relationships remain largely theoretical and under-examined (Custer et al., 2012; McComb & Simpson, 2013; Westli et al., 2010). In the healthcare literature examining SMMs, the most frequently mentioned immediate consequence of SMM is the team process of implicit coordination (Burtscher & Manser, 2012; Gillespie, Chaboyer, Longbottom, & Wallis, 2010; Leonard et al., 2004; Lyndon et al., 2012; McComb et al., 2012; Salas et al., 2008; Toecafondi et al., 2012; Westli et al., 2010). Salas et al. (2008) described the immediate consequence of SMM as allowing teams to “recognize opportunities to provide support, guidance, and information to their teammates to achieve common goals” (p. 338). Implicit coordination allows team members to anticipate the actions and needs of others as well as the ability to adjust behavior without overt communication (Gillespie et al., 2010; McComb et al., 2012; Westli et al., 2010). However, measuring implicit coordination in field studies for complex tasks is difficult (to nearly impossible) because it is not observable, and the team may not be cognitively aware of its presence. Yet, theoretically, measuring the quality of the discharge teams’ Teamwork SMM provides a viable proxy indicator for a teams’ capacity to effectively coordinate care when discharging the patients.
Other potential performance outcomes of team SMMs described in the healthcare literature include improved teamwork performance (Burke et al., 2004; Burtscher & Manser, 2012; Gillespie et al., 2010; Leonard et al., 2004; Lyndon et al., 2012; McComb & Simpson, 2013; Salas et al., 2008; Toccafondi et al., 2012; Undre et al., 2006; Westli et al., 2010), improved task performance (Burtscher & Manser, 2012; Custer et al., 2012; Dulkerian, Douglas, & Taylor, 2011; Gillespie et al., 2010; Leonard et al., 2004; Lyndon et al., 2012; McComb & Simpson, 2013; Miller et al., 2009; Salas et al., 2008; Toccafondi et al., 2012), increased quality of decision making (Dulkerian et al., 2011), and improved patient safety (Burke et al., 2004; Gillespie et al., 2010; Haig, Sutton, & Whittington, 2006; Leonard et al., 2004; Lyndon et al., 2012; Manser, 2009; Miller et al., 2009; Millward & Jeffries, 2001; Salas et al., 2008; Westli et al., 2010). However, very few studies have measured healthcare SMMs or examined SMM relationships with team performance.

Conceptual Framework

Although SMMs are suspected to be integral to team implicit coordination in healthcare, little is known about how the team’s distribution of shared knowledge impacts the team’s ability to prepare the patient for self-management after discharge (Ashbrook et al., 2013). The theorized relationships among SMMs, convergence, and patient post-hospitalization outcomes are illustrated in the conceptual model guiding this study (Figure 5). Appendix A includes key definitions of terms used in this dissertation.

Inputs

For this study, the input variables are the factors that place patients at risk for poor self-care management, adverse events, and readmissions post-hospitalization. Throughout Chapter 2, several inputs were identified (see Table 2). Figure 5 provides an overview of the patient-, team-, and unit-level inputs that were initially included as variables for this study. More specifically, the patient-level inputs include principal diagnosis, age, gender, race, marital status, housing type, household occupancy, educational attainment employment status, insurance payer, planned admission, number of recent hospitalizations, number of recent emergency room visits, length of hospitalization stay, intensive care admission, number of medications upon discharge, number of comorbidities, cognition, coping ability, and expected support. The proposed team-level inputs included the discharge team’s individual providers’ years of professional experience (bedside nurse, discharge coordinator, physician), individual providers’ years of hospital experience (bedside nurse, discharge
coordinator, physician), individual providers’ years of unit experience (bedside nurse, discharge coordinator, physician), individual providers’ educational background (bedside nurse, discharge coordinator, physician), team-level years of professional experience, communication quality, teamwork quality, number of float staff, team communication, patient-team communication, new day of discharge team, and team perception of safety. Last, the type of inpatient unit (medical, cardiology, and orthopedic) is examined. These variables are listed in the inputs section of Figure 5 and are described in Chapter 3.

**Team Processes**

Processes describe the members’ interactions that are directed toward task accomplishment and how team inputs are transformed into the outcomes (Mathieu et al., 2008). For this study, the team process of interest is the discharge team’s SMM. Based on the hospital discharge literature, two specific SMM content domains were identified as shared knowledge that the team needs to successfully prepare the patient for discharge, including (a) each other’s roles and responsibilities involved in discharging the patient (Teamwork SMM) and (b) how ready the patient is for discharge (Taskwork SMM). Additionally, the SMM properties of convergence of teamwork and taskwork as well as accuracy of taskwork were examined. The relationships between the content of the discharge teams’ SMMs (Teamwork SMMs and Taskwork SMMs), SMM properties (Teamwork SMM Convergence, Taskwork SMM Convergence, and Taskwork Accuracy), and patient outcomes are illustrated in Figure 5, while the measurement approaches are outlined in Chapter 3.

**Outputs**

Outputs are the result of the team’s activities and include the performance and members’ affective reactions (Mathieu et al., 2008). The outputs of interest for this study are the patients’ 30-day post-hospitalization outcomes (e.g., quality of transition, and unplanned utilization of medical services). The study outcomes are depicted in Figure 5, and are then further explained in Chapter 3.

**Summary**

The literature review in Chapter 2 provides an overview of (a) the problems related to the discharge process, (b) approaches used to address these problems, (c) gaps in the literature, and (d) how this study will begin to address the identified gaps. The next chapter will provide an overview of the research design and methodology used for this study.
Figure 5. Conceptual model illustrating the theorized relationships among patient/team/unit characteristics (inputs), shared mental models’ (SMMs’) content and properties (process), and patient post-hospitalization outcomes (outputs).
CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

The purpose of this prospective longitudinal pilot study was to examine the content of SMMs among inpatient discharge team members (i.e., nurse, attending physician, and discharge coordinator), and the influence of SMMs on patients’ post-hospitalization outcomes (quality of transition and utilization of unplanned medical services). Chapter 3 outlines the methodology and design of the study.

Design Overview

This pilot study used a prospective longitudinal design to examine discharge team SMMs, and their influence on patient post-hospitalization outcomes. A pilot is defined as “a small-scale study that helps to examine the practicality and feasibility of the methods to be used in a subsequent larger and more comprehensive investigation” (Viechtbauer et al., 2015, p. 1375). There are three primary reasons that a pilot approach was used for this study. First, studying healthcare teams in clinical practice (real-time in the field) is challenging (Ashbrook et al., 2013), and only a few studies have examined the SMMs of healthcare teams (Burtscher & Manser, 2012; Kalisch, 2009; McComb et al. 2012; Toccafondi et al., 2012; Westli et al., 2010). Second, there are limited established research procedures (e.g., study designs, data collection methods, and analysis techniques) for examining the relationship between team processes and patient outcomes. Last, estimating an appropriate sample size is difficult because the effect of SMMs on clinical practices and outcomes is relatively unknown. The results of this study will be used to (re)examine the proposed conceptual framework, select variables, and estimate power for future studies. Piloting procedures to measure SMM will advance the healthcare systems field’s ability to capture the role of interprofessional care teams in preparing patients for a safe, high quality, patient-centered hospital discharge.

For this prospective longitudinal pilot study, patients and discharge team members involved in 72 discharge events were enrolled at one hospital across three inpatient units (Cardiology, Orthopedic, and Medical). The unit of analysis was discharge events – which includes the patient and his or her discharge team providers (nurse, physician, and discharge coordinator). On the day of hospital discharge, patients completed a questionnaire with demographic information and the Readiness for Hospital Discharge Scale (RHDS).
Providers completed a questionnaire containing demographic information, team characteristics, the Discharge Provider-Readiness for Hospital Discharge Scale/Short Form (DP-RHDS/SF), and the Shared Mental Models Scale.

Approximately 30-days after hospital discharge, either by phone or by mailed questionnaire, the post-hospitalization outcome data were collected from the patient. The quality of transition was measured using the Care Transition Measure (CTM-15). Additionally during the follow-up patients reported if they utilized unplanned medical services, which was defined as returning unexpectedly to the emergency room and/or being admitted to the hospital within 30-days post-discharge. Of the initially enrolled 72 discharge events, 64 (88%) of discharge event participants completed all of the day of discharge questionnaires, 58 (81%) of patients responded to the unplanned utilization of medical services outcome, and 42 (58%) of patients responded to the quality of transition outcome.

Aim 1 was to determine the degree of convergence for discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units. A total of 64 completed discharge events were analyzed for Aim 1. Provider’s IMMs of teamwork were measured using the Shared Mental Models Scale, while taskwork IMMs were measured using the DP-RHDS/SF. Individual team member’s mental models were aggregated to create a new team-level cognitive structure (Teamwork and Taskwork SMMs) by averaging the individual scores on these measures. To determine the degree of convergence of Teamwork SMM for each team an interrater agreement index ($r_{wg}^*$) was calculated from the provider scores on the Shared Mental Models Scale (Aim 1A). Likewise, to determine the Taskwork SMM of each team an $r_{wg}^*$ was calculated from the provider scores on the DP-RHDS/SF (Aim 1B). Additionally, separate Analysis of Variances (ANOVAs) were conducted to compare the effects of inpatient unit (Medical, Orthopedic, and Cardiology) on Teamwork SMMs, Taskwork SMMs, Teamwork SMM Convergence, and Taskwork SMM Convergence (Aim 1C).

Aim 2 was to determine the relationship between discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units and patients’ 30-day post-hospitalization outcomes (quality of transition and utilization of unplanned medical services), while controlling for contextual unit and patient characteristics. To address Aim 2, separate regression models were built and analyzed to examine the quality of transition ($n = 42$ discharge events) and the utilization of unplanned of medical services ($n = 58$ discharge events). A modified AICc (Akaike Information Criterion Corrected) stepwise model
selection procedure was used to develop a linear regression model for the quality of transition outcome (CTM-15), and a logistic model for the utilization of unplanned medical services outcome (Aim 2A and 2B). Last, for both models the proposed interactions of interest (Teamwork SMM x Teamwork SMM Convergence, Taskwork SMM x Taskwork SMM Convergence, and Taskwork SMM x Taskwork Accuracy) were examined (Aim 2Ai, 2Bi, 2Bii).

**Setting**

Data collection occurred from January 2017 to October of 2017 at a hospital in Iowa City, Iowa. The site was a community hospital and regional referral center for 10 rural counties in southeastern Iowa. This hospital has approximately 8,273 hospital admissions each year. Discharge events were collected from three inpatient units: Cardiology unit (32 beds), an Orthopedic unit (27 beds), and a Medical unit (29 beds). The Chief Nursing Officer, Chief Medical Quality Officer, and Privacy Officer offered support for the project (Appendix B). The following sections provide a description of the inpatient units, as well as the hospital’s patient population.

**Inpatient Unit Descriptions**

Patients admitted to the Medical unit have a variety of acute and chronic conditions, but were not expected to require a surgical intervention and/or be in need of cardiac monitoring using telemetry. The majority of patients admitted to the Medical unit at this hospital are cared for by the hospitalist medicine team. Examples of the principal diagnoses of patients on the Medical unit include asthma exacerbation, pneumonia, cellulitis, gastrointestinal bleeds, acute and chronic renal failure, alcohol withdrawal, and chronic obstructive pulmonary disease.

The Orthopedic unit provides services for a range of orthopedic conditions, including planned surgeries on the spine and upper and lower extremities. The majority of patients on the Orthopedic unit were admitted for either hip or knee replacements. The Orthopedic unit collaborates with surgeons from a local orthopedic clinic. Additionally, the Orthopedic unit has received several specialty quality of care awards, such as the 2017 Healthgrades Orthopedic Surgery and The Joint Replacement Excellence Award.

The Cardiology unit provides specialized care for patients with heart or respiratory conditions, as well as other diagnoses that require cardiac monitoring. The Cardiology unit includes patients that are cared for by hospitalists, cardiologists, and cardiac surgery services.
The hospital’s cardiology department includes a specialized cardiac catheterization and surgery program, which preforms interventional procedures such as in percutaneous transluminal coronary angioplasty, coronary stenting, and rotational atherectomy. Additionally, hospital’s Cardiology Unit is certified as a Chest Pain Center by the Society of Cardiovascular Patient Care, as well as a Blue Distinction Center for Cardiac Care by Wellmark Blue Cross and Blue Shield.

**Hospital Patient Population**

The hospital primarily provides care to patients from Johnson County, Iowa. According to 2010 US Census Bureau, for Johnson County residents over the age of 65, approximately 56.63% are female and approximately 96.01% are white. Other ethnicities are reported approximately as follows: black/African American (non-Hispanic) 1.2%, Asian (non-Hispanic) 2.02%, Hispanic/Latino (any race) 1.05%, more than one race, 0.45%, and other ethnicities 0.45% (US Census Bureau, 2010).

**Sample**

**Patient Participants**

The target population of interest is inpatient older adults with high-risk conditions who are at risk for poor quality of transitions from the hospital to home. Patient inclusion criteria were: 1) \( \geq 65 \) years, 2) community-dwelling prior to hospitalization, 3) discharged directly home without home health services or hospice care, and 4) admitted with a principal diagnosis of heart failure (HF), acute myocardial infarction (AMI), hip replacement, knee replacement, pneumonia, or chronic obstructive pulmonary disease (COPD). In particular, this study sampled from patients admitted with HF or AMI (from the Cardiology unit), hip replacement or knee replacement (from the Orthopedic unit), and pneumonia or COPD (from the Medical unit). Exclusion criteria was the inability to complete study forms because of either mental incapacity (score \( \geq 7 \) on Short Portable Mental Status Questionnaire; Pfeiffer, 1975) or language barrier. Notably, an effort was made to exclude participants who were admitted with multiple active conditions from the six principal diagnoses of interests. This was achieved by reviewing the patient’s admission note active problem list.

**Patient population rationale.** There are several reasons that older adults with these six principal diagnoses were selected as the patient population of interest. First, there is a high frequency (both nationally and the study site) of older adult admitted to the hospital with these diagnoses (Mattison et al., 2012). Second, older adults with these admitting
diagnoses are at high risk for readmission and/or complications post-hospitalization (Goodman, Fisher, Chang, 2013; Dharmarajan et al., 2013; Fingar & Washington, 2014; McDonald et al., 2007). And, third, these diagnoses are the focus for the Center of Medicare Services Hospital Readmission Program (Goodman, Fisher, Chang, 2013; Dharmarajan et al., 2013; Fingar & Washington, 2014; McDonald et al., 2007). Finally, focusing on two specific diagnoses allows for some heterogeneity of the sample with in each unit, while also minimizing the potential effects of extraneous variables.

Provider Participants

A review of the literature and discussions with local hospital staff revealed the bedside nurse, attending physician, and discharge coordinator (a nurse or social worker allocated to discharge planning for the unit) were the key inpatient staff members to discharging patients (AHRQ, 2014; Ashbrook et al., 2013; Goodman et al., 2013). These providers play a critical role in providing the appropriate timing of, and activities involved with, day of discharge tasks (e.g. education, arranging resources, completing paperwork). Therefore, the discharge team was defined as the bedside nurse (RN), attending physician (MD), and discharge coordinator (DC) responsible for the patient’s care on the day of hospital discharge. The inclusion criteria for the provider participants included, 1) be the bedside RN, attending MD, or DC caring for the patient participant, 2) either have received handoff or have cared for the patient during the current hospitalization, and 3) not previously participated in the study with the same discharge team members. In order to maximize the number of unique inpatient discharge teams, discharge teams with the same RN, MD, and DC could only participate one time. Therefore, providers were enrolled in the study once, but could be surveyed more than once.

Sampling Approach

A non-probability convenience sampling approach was used to sample potentially eligible participants meeting the specific principal diagnosis inclusion criteria (Gerrish & Lacey, 2010). A total of 72 discharge events were enrolled in the study, which included 24 discharge events per the three inpatient units. The sample size for a pilot depends on the purpose and feasibility of the study (Hertzog, 2008). The purpose of this study was to determine the feasibility of measuring SMMs in discharge teams (Aim 1), as well as explore the relationship between discharge teams’ SMMs and patient post-hospitalization outcomes (Aim 2). Although there is no gold standard for determining sample sizes of pilot studies,
setting an appropriate sample size is still an important consideration for researchers (Hertzog, 2008). For example, if a pilot study sample size includes too many participants, the study may cause unnecessary burden to participants or be unfeasible (Creswell, 2014; Grove, Burn, & Gray, 2013). Yet a study with too small of a sample may negatively impact the design of future studies by imprecisely estimating variables (Gerrish & Lacey, 2010). The sample size for this pilot study was determined using power analysis, while also taking into consideration the feasibility of data collection based on the available pool of participants, and the potential for patient participants dropping out during the 30-day follow-up period.

**Power analysis.** Power analysis is a statistical procedure used for estimating the sample size needed to obtain a sufficient power for a study. Three parameters - power, effect size, and alpha - are used in power analysis. Power is the capacity of the study to detect the differences or relationships that actually exist in the population and is inversely related to the probability of making a Type II error (power = 1 – \( \beta \)) (Grove et al., 2012). Effect size (\( ES \)) is the extent to which the phenomenon is present in the population (Grove et al., 2012; Cohen, 1988). The effect size is also thought of as the degree to which the null hypothesis is false (Cohen, 1988). While the alpha level (\( \alpha \)) is related to Type I Error or the probability of finding significant results, where there actually is none (Cohen, 1988).

The initial sample size estimation of 60 completed discharge events was determined using G*Power Software with \( \alpha = .05 \), power = 80, and a large \( ES (r) = .35 \). Schmutz and Manser’s (2013) systematic literature review identified a large \( ES \) for team process on clinical outcomes. The sample size estimation of 60 takes into consideration the four predictor variables of interest (Teamwork SMMs, Taskwork SMMs, Teamwork SMMs Convergence, Taskwork SMMs Convergence), and six covariates (patient age, gender, length of hospital stay, number of comorbidities, principal diagnosis, and inpatient unit type).

**Estimated available pool of participants.** Data provided by Mercy Hospital’s quality improvement specialist was used to estimate the available pool of patient and provider participants. Table 3 provides an overview of the estimated available pool of patients and providers for each unit. The estimated available pool of provider participants per unit includes 10-16 MDs, 23-40 RNs, and 1-2 DCs. Additionally, IDC-9 Codes were used to estimate the average number of patients per month that were admitted with the six key principal diagnoses (Table 3). Depending on the principal diagnosis, the estimated average number of available patients ranged from 12 to 67 admissions per month. Therefore
a 4-month data collection period was proposed in order to recruit 12 patients for each of the six principal diagnoses.

However, initial estimates of potential patient participants did not take into consideration the following factors: patient age, patients being discharged directly home without home health or hospice, and patients having more than one of the principal diagnoses of interest. Additionally, the work schedule of the DCs limited patient recruitment. Patient participants could only be recruited if their discharge occurred Monday through Friday, as these were the days that the DCs worked. Two weeks into data collection, the timeline and sampling plan for the study was re-examined. The data collection period was extended to total of eight months in order to reach a recruitment goal of 60 completed discharge events.

**Anticipated attrition.** Based on power analysis, the initial sample goal was to collect 60 completed discharge events. Due to the longitudinal nature of data collection and having multiple participants connected with a discharge event, a 20% attrition rate was used to account for the withdrawal of participants. Therefore a total of 72 discharge events (or 24 discharge events per unit) were recruited for the study.

<table>
<thead>
<tr>
<th>Unit</th>
<th># of Providers</th>
<th>Principal Diagnosis</th>
<th>ICD-9 Codes</th>
<th>Average admissions per month*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiology</td>
<td>10 23 1</td>
<td>HF AMI</td>
<td>428 410</td>
<td>17 23</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>16 37 2</td>
<td>Hip Replacement Knee Replacement</td>
<td>715.35 715.36</td>
<td>25 67</td>
</tr>
<tr>
<td>Medical</td>
<td>12 40 2</td>
<td>Pneumonia COPD</td>
<td>480-483, 485-487, 488.11 490-494, 496</td>
<td>12 12</td>
</tr>
</tbody>
</table>

*Average number of admissions per month in 2014
Variables

McGrath’s (1964) IPO model was used as a framework to examine how the inpatient healthcare team influences patient post-discharge outcomes. Figure 5 provides an overview of the theorized relationships among SMMs and patient post-hospitalization outcomes.

Input (Covariate Variables)

According to the IPO model, inputs describe the antecedent factors that enable and constrain team member action (McGrath, 1964). Table 4 provides a full description of the Input variables. The input variables are categorized into three groups:

1. Patient Characteristics
2. Provider Characteristics
3. Team Characteristics
4. Inpatient Unit (Environment) Characteristics.

**Patient characteristics.** Patient characteristics include principal diagnosis, age, gender, race/ethnicity, marital status, housing type, household occupancy, educational level, employment status, insurance payer, planned admission, number of recent hospital admissions, number of recent emergency department (ED) visits, length of stay, Intensive Care Unit (ICU) admission, number of medications, and number of comorbidities. These variables were collected from the patient or review of the patient’s medical records using an investigator-developed demographic questionnaire.

**Principal diagnosis.** The Principal Diagnosis is the condition chiefly responsible for the admission of the patient to the hospital (Lefert, 2009). The six principal diagnoses categories include HF, AMI, Hip Replacement, Knee Replacement, Pneumonia, and COPD. The principal diagnosis was determined by manually reviewing the patient’s medical record (e.g., admission note, progress notes, and/or after visit summary) and then verifying with the patient using the demographic questionnaire.

**Age.** Participants were asked to self-report the number of years they have been alive at the time of the hospitalization. Age was used as a continuous variable and was recorded in years using the demographic questionnaire.

**Gender.** Gender is the self-reported physical and/or social conditions of being a male or a female (Cambridge Dictionary, 2017). Gender was based on patient self-report from the patient demographic questionnaire. Participants selected from one of the following
categories: female, male, or other. Based on participant responses, the final categories used were dichotomized (female vs. male).

**Race/ethnicity.** Race is defined as the differences between groups of people that share physical or genetic characteristics (Cambridge Dictionary, 2017b). Ethnicity can be viewed as the heritage, nationality, lineage, or country of birth of the person (e.g., Hispanic origin; US Census Bureau, 2018). Race/ethnicity was determined using participant self-report from the patient demographic questionnaire as a nominal categorical variable. The US Census Bureau (2018b) categories were used: Asian, black, Native American, Hispanic, white non-Hispanic, and other. Participants were able to report multiple race/ethnicity categories. Due to the limited number of non-white responses, the categories were dichotomized into white (non-Hispanic, non-Native American) and non-white (black, Hispanic, Native American, and other).

**Marital status.** Marital status was defined as the “civil status of each individual in relation to the marriage laws or customs of the country” (Organization for Economic Co-operation and Development, 2006). Marital status was determined by participant self-report using the patient demographic questionnaire. Patients were asked to select from the following marital status categories: never married, married, separated/divorced, and/or widowed. Participants were able to report multiple marital status categories. Based on participant responses the final categories were dichotomized into married or single (never married, separated/divorced, and/or widowed).

**Housing type.** The variable housing type refers to the dwelling and living situation of the participant (Homebase for Housing, 2018). In the demographic patient questionnaire, participants were asked to select one of the following categories regarding “where they live most of the year” including the home/apartment/condo, a senior citizen apartment/condo, the home of a relative/friend, a retirement home, a nursing home, or other. Based on participant responses the final categories were dichotomized into living at home (the individuals or friends home, apartment, or condo) or an independent living senior citizen apartment.

**Household occupancy.** According to the US Census Bureau (2010b), a household includes all the people who are occupying a housing unit. To identify household occupancy, a question in the demographic questionnaire asked participants to select one of the following categories: I live alone, I live with one person, I live with two people, I live with three
people, or I live with four or more people. Based on participant responses the final ordinal categories, including living alone, living with another person, or living with two or more persons.

**Educational attainment.** Educational attainment is defined as the highest level of education that the participant has completed (US Census Bureau, 2018). Educational attainment was collected using participant self-report on the demographic questionnaire. To determine the years of formal schooling completed, participants were asked, “How much schooling have you had?” The initial six educational attainment categories included: 8th grade or less, some high school, high school graduate or General Educational Diploma (GED), some college or technical school, college graduate (bachelor’s degree), and a graduate degree. Based on participant responses the final ordinal categories were collapsed into three categories: non-high school graduates (completed 8th grade or less, or some high school), high school graduate or GED, and some college or greater education (some college or technical school, college graduate, and graduate degree).

**Employment status.** An individual is classified as employed if the person is either an employee or are self-employed (Edgell, Gottfried, & Granter, 2015). Employment status was collected using participant self-report on the demographic questionnaire. Participants were asked to select the following categories to describe current employment status, including: working full-time (> 35 hours a week), working part-time (< 35 hours a week), unemployed or laid off (looking for work), unemployed (not looking for work), homemaker, in school, retired, disabled (not able to work), and/or other. Participants were able to select multiple categories. Based on participant responses the final nominal categories were collapsed: working (working full time and/or working part-time), unemployed (unemployed or laid off, unemployed not looking for work, retired, homemaker, and/or disabled).

**Insurance payer.** The variable insurance payer is defined as the insurance plan(s) the participant has had in the past 12 months. Insurance payer was collected using participant self-report using the demographic questionnaire. The categories include individual plan (member pays for the plan premium), group plan through an employer, union, etc. (employer pays all or part of the plan premium), US Governmental Health Plan (e.g., Military, Veterans Administration), Medicaid, Medicare, and/or no insurances plan. Participants were allowed to select multiple insurance payer categories. Based on participant responses the nominal categories were collapsed: individual or group plan only (individual
plan, group plan through an employer, or US Governmental Health Plan), Medicare only, Medicare and an individual/group plan, or dual Medicare and Medicaid.

**Planned admission.** The hospital admission was considered planned if the patient expected to be admitted to an inpatient unit 48-hours prior to hospitalization (Gruneir et al., 2011; Nguyen et al., 2016). The planned admissions variable was collected using self-report from the demographic questionnaire. The responses were recorded as dichotomous: yes (admission was planned) or no (admission was unplanned).

**Number of recent hospital admissions.** A recent hospital admission was defined as being admitted to the hospital with in the last 12 months prior to the current hospitalization (Nguyen et al., 2016). The number of recent hospital admissions was identified using patient self-report on the demographic questionnaire.

**Number of recent emergency department visits.** A recent ED visit was defined as going to the ED for care during the 12 months prior to the current hospitalization (van Walraven et al., 2010). The number of recent ED visits was identified using self-report in the demographic questionnaire.

**Length of stay.** Length of Stay (LOS) is defined as duration of time the patient was admitted to the hospital (Ross et al., 2008). The number of inpatient days was calculated by subtracting day of hospital admission from the day of hospital discharge (Ross et al., 2008). The patient’s LOS was collected from the patient demographic questionnaire, and was then verified by the researcher with the medical record.

**Intensive Care Unit (ICU) admission.** An ICU admission was defined as the patient having received care from the critical care unit during the hospital stay of interest (Picker et al., 2015). The patient’s medical record was examined for the presence of a physician ICU note and recorded as a dichotomous variable. If an ICU note was present, then the patient was determined to have an ICU admission (yes). Patients that did not have a physician ICU note were recorded as not having an ICU admission (no).

**Number of discharge medications.** The number of medications at time of discharge was identified from the discharge home medication list (Wimmer et al., 2014; Picker et al., 2015). Only the daily prescribed medications were included; the as needed (or PRN) and/or duplicate medications were excluded.
**Number of comorbidities.** The number of comorbidities (chronic diseases) was determined by counting the number of conditions from the ICD-10 codes problem list listed on the physician’s discharge summary note (Picker et al., 2015).

**Level of cognition.** Level of cognition was identified with the Short Portable Mental Status Questionnaire (SPMSQ), which is a widely used 10-item scale used to distinguish cognitively impaired subjects from cognitively intact subjects (Pfeiffer, 1975). The topics covered in the SPMSQ included the date, day of the week, name of this place, patient’s telephone number, age, birthdate, current president of the United States, previous president of the United States, mother’s maiden name, and a serial number subtraction task (Pfeiffer, 1975). The number of errors (or incorrect responses) reflects the participant’s cognitive functioning level. Pfeifer (1975) determined that the number of errors correspond to the following intellectual function categories intact (0-2 errors), mild (3-4 errors), moderate (5-7 errors), and severe (8-10 errors).

**Expected support.** According to Weiss et al. (2013), expected support at time of hospital discharge is the availability of emotional and physical assistance post-hospitalization. Patient participant’s level of expected support was collected in the patient demographic questionnaire with the RHDS expected support subscale. The subscale includes two questions using a Likert scale, patients were asked to indicate on a scale of “0” (none) and “10” (a great deal) how much help they will have at home with personal and medical care. The two items of the subscale were averaged to yield a single score for level of expected support (Weiss et al., 2013).

**Coping ability.** According to Weiss et al. (2013), coping ability is the patient’s ability to cope with medical, as well as personal, tasks post-hospitalization at home. Coping ability is used as a proxy for patient’s level of difficulty with activities of daily living and expected ability to function at home. Patient participant level of coping ability was collected in the patient demographic questionnaire via the RHDS coping ability subscale. The subscale includes two questions using a Likert scale; patients were asked to indicate on a scale of “0” (not at all) and “10” (extremely well) how well they will be able to handle the demands of life and perform personal care activities at home. The two items of the subscale were then averaged together to yield a single score for level of coping ability (Weiss et al., 2013).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Defined</th>
<th>Operationalized*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal diagnosis</td>
<td>Condition responsible for hospital admission</td>
<td>HF; AMI; HR; KR; PNA; COPD</td>
</tr>
<tr>
<td>Age</td>
<td>Number of years alive</td>
<td>Years</td>
</tr>
<tr>
<td>Gender</td>
<td>Self-identified physical and/or social conditions of being a male of a</td>
<td>Male, Female</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>Self-identified physical/genetic background</td>
<td>White, Non-white</td>
</tr>
<tr>
<td>Marital status</td>
<td>Civil status</td>
<td>Married, Single</td>
</tr>
<tr>
<td>Housing type</td>
<td>Dwelling and living situation</td>
<td>Home, apartment, or condo; Independent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>living senior citizen apartment</td>
</tr>
<tr>
<td>Household occupancy</td>
<td>Number of individuals living in the household</td>
<td>Live alone, 1 person, 2+ people</td>
</tr>
<tr>
<td>Educational attainment</td>
<td>Highest level of education that the participant has completed</td>
<td>Non-high school graduates, High school</td>
</tr>
<tr>
<td></td>
<td></td>
<td>graduate, Some college or greater</td>
</tr>
<tr>
<td>Employment status</td>
<td>Labor force activity</td>
<td>Working, Unemployed, Retired</td>
</tr>
<tr>
<td>Insurance payer</td>
<td>Insurance plan type</td>
<td>Medicare, Medicaid/Medicare, Private/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>group plan, Private/group plan and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medicare</td>
</tr>
<tr>
<td>Planned admission</td>
<td>Aware of hospitalization 48 hours prior</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Number of recent</td>
<td>Number of hospital admissions in the last 12 months</td>
<td>Numerical count</td>
</tr>
<tr>
<td>hospitalizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of recent ED</td>
<td>Number of ED visits in the last 12 months</td>
<td>Numerical count</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>Duration of days admitted to the hospital</td>
<td>Days</td>
</tr>
<tr>
<td>ICU admission</td>
<td>Received care from the critical care unit during the hospital stay</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Number of discharge</td>
<td>Number of medications on home medication lists</td>
<td>Numerical count</td>
</tr>
<tr>
<td>medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of comorbidities</td>
<td>Number of conditions on physician’s discharge note problem list</td>
<td>Numerical count</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of cognition</td>
<td>Short portable mental status score</td>
<td>0-7</td>
</tr>
<tr>
<td>Coping ability</td>
<td>Coping ability with medical and personal tasks at home</td>
<td>RHDS coping ability subscale (0-10)</td>
</tr>
<tr>
<td>Expected support</td>
<td>Availability of emotional and physical assistance post-</td>
<td>RHDS expected support subscale (0-10)</td>
</tr>
<tr>
<td></td>
<td>hospitalization</td>
<td></td>
</tr>
</tbody>
</table>

*Collapsed categories
**Provider characteristics.** To describe the provider participant sample, the provider demographic questionnaire was used to collect the following variables: educational level, years of profession experience, years of hospital experience, years of unit experience, gender, age, and perception of safety (Table 5).

*Provider educational level.* The provider educational level is the individual’s highest completed degree. The following categories to select from included: Associate’s Degree in Nursing (ADN), Bachelor of Science in Nursing (BSN), Doctor of Osteopathic (DO), Doctor of Medicine (MD), Master of Science in Nursing (MSN), Master of Social Work (MSW), and other.

*Provider age.* The provider’s age was the number of years they had been alive.

*Provider gender.* Provider gender (self-identified physical and/or social conditions of being a male of a female) was collected using the provider demographic questionnaire.

*Provider experience.* The provider’s experience in the healthcare workforce was capture using three categories: years of profession experience (number of years since graduation from professional school), years of inpatient unit experience (number of years worked at the hospital), and years of hospital experience (number of years worked at the hospital). These were each examined separately and by provider type.

*Provider perception of safety.* The Global Patient Safety Grade is a single-item question used to assess the individual provider’s perception of safety (Sorra & Dryer, 2010). Providers were asked to “give your unit an overall grade on patient safety” on a five-point scale (*failing* [1] to *excellent* [5]). The Global Patient Safety Grade item is from the validated and widely used Hospital Survey on Patient Safety Culture (Sorra & Dryer, 2010).
Discharge team characteristics. Several team-level variables were collected; an overview is provided in Table 6. Depending on the type of team-level variable, the discharge team characteristics for each discharge event were examined in various ways. The variables educational level and experience by provider types are both examples of composition team-level variables (Levine & Moreland, 1990), and therefore can be examined as both individual and team-level characteristics. However for Aim 2, these variables were conceptualized at the team level. In addition to team composition variables, some of the individual provider characteristics were aggregated to the team level. Aggregation involves transforming individual-level data to the team level. Aggregation allows researchers to capture emergent properties or when a behavior, cognition, or effect of an individual is amplified by the interactions with others resulting in a higher-level collective phenomenon (Klein & Kozlowski, 2000). Although there is no established gold standard for the aggregation of team-level characteristics, theory and context of team/task are useful to inform the appropriate selection of aggregation methods (Levine & Moreland, 1990; Klein & Kozlowski, 2000). The aggregation method used for key discharge team-level characteristics are discussed by variable. Last, additional key team-level factors were examined including frequency of team interactions, number of float staff, and day of discharge communication patterns.
**Professional experience.** The level of professional experience of the discharge team was captured using multiple approaches. First, the provider (RN, DC, MD) years of professional experience was not only considered at the individual level, but also at the team-level. It is possible that the provider years of professional experience is an example of a configural team-level property (an individual level characteristic that describes a key characteristic within the team; Klein & Kozlowski, 2000). Configural properties originate at the individual level and do not necessarily need to be coalesced among the team (Klein & Kozlowski, 2000; Kozlowski & Bell, 2003). It is possible that teams with older or younger providers, or that have a mixture of both, could impact how the team members interacts, socializes, and provides care. Therefore, the same method for examining the provider’s individual level of experience was used for the provider’s team-level characteristic of professional experience.

**Team level of professional experience.** In addition to examining the professional experience of the RN, DC, and MD of the discharge team, experience in the profession was also examined at an aggregated level. Although there are several ways to measure team level of experience, the average of the individual providers’ years of experience has been used in the team literature (Huckman, Staats, & Upton, 2009). Team level of experience was calculated by averaging the number of years since graduation from professional school for each of the discharge team members.

**Team level of hospital experience.** Similar to team level of professional experience, team level of experience of inpatient hospital experience was calculated by averaging the number of years of working at the site-specific hospital for each team member.

**Discharge team educational background.** The educational background of providers that make up the discharge team are another example of a configural team-level property (Klein & Kozlowski, 2000). There were three key variables of interest regarding the team’s educational level for each discharge event. The first variable of interest was the educational level of the RN (ADN vs. BSN) for each discharge event. The second variable of interest was the educational background of the DC (ADN, BSN, or MSW) for each discharge event. The third variable of interest was the educational background of the MD (MD vs. DO) for each discharge event. The educational level of the provider was determined from the provider’s demographic questionnaire.
Communication quality. The communication quality of day of discharge team measure was adapted from Millward and Jeffries (2001) Team Survey. For each discharge event, using a 7-point Likert scale (strongly disagree [1] to strongly agree [7]), the individual providers rated their agreement with the following phrase: “overall, the team communicated appropriately while discharging this patient from the hospital.” The variable was collected using the Provider Transition to Home Survey on the day of patient discharge. The communication quality was aggregated to the team level by calculating the average of the RN, MD, and DC individual scores. Theoretically, similar perception of the quality of communication should exist when working as a team (Klein & Kozlowski, 2000), thus an average of the individual team member scores was used to aggregate the team’s communication quality. Interrater agreement indexes such as $r_{wg}$ are used to examine the level of consensus between individual members of the team (LeBreton & Senter, 2008). To verify if the average was appropriate to use as an aggregation method, an $r_{wg}$ was calculated for each discharge event. In the team literature, if an $r_{wg}$ is .7 or greater, than it is appropriate to aggregate the variable to the team-level (Lance, Butts & Michels, 2006).

Teamwork quality. The quality of day of discharge teamwork was adapted from Millward and Jeffries (2001) teamwork evaluation question. For each discharge event, using a 7-point Likert scale (strongly disagree [1] to strongly agree [7]), the individual providers rated their agreement with the following phrase: “I feel that we worked together as a team to prepare this patient for hospital discharge.” The variable was collected using the Provider Transition to Home Survey on the day of patient discharge. The teamwork quality was aggregated to the team level by taking the average of the RN, MD, and DC individual scores. Similar to the communication quality variable, theoretically teams should share similar perception of the quality of teamwork (Klein & Kozlowski, 2000). To verify if the average was appropriate to use as an aggregation method, an interrater agreement index ($r_{wg}$) was calculated for each discharge event.

Number of float staff. Mercy Hospital had RNs, DCs, and MDs that were considered to be “float staff,” or staff that were not assigned to a dedicated inpatient unit. The provider demographic questionnaire was used to identify if the provider (RN, DC, MD) was a float staff. The number of float staff (staff members without a dedicated inpatient unit) on the discharge team for each discharge event was counted.
**Team communication.** The team communication variable captures if all the team members communicated (or did not communicate) on the day of discharge. Using the Provider Transition to Home Survey, for each discharge event the providers were asked to indicate how many times they communicated with the following individuals on the day of hospital discharge: patient, family, RN, DC, and MD. For each discharge team, all providers’ responses on were reviewed for evidence that the RN, MD, and DC communicated to each other on the day of discharge. The communication section of the Provider Transition to Home Survey was examined to see if the RN spoke with the MD, the RN spoke with the DC, and the DC spoke with the MD. The full team communication variable was dichotomous (yes vs. no). If there was evidence of communication between all pairs of providers, the team had full communication (yes). If there was no evidence of communication between all providers, then it was determined not all of the team members communicated with one another on the day of discharge (no).

**Team-patient communication.** There is evidence to suggest that providers communicating directly with the patient on the day of discharge may impact their perception of the patient’s readiness for hospital discharge and/or understanding of the team’s needs (Epstein, Fiscella, Lesser, & Strange, 2010). The team-patient communication variable describes if all the members communicated directly with the patient on the day of hospital discharge. For each discharge event, all provider responses to the communication question on the Provider Transition to Home Survey was reviewed for evidence that the RN, MD, and DC communicated with the patient on the day of discharge. The team communication with patient variable was dichotomous (yes vs. no). If there was evidence of communication between each provider and the patient, then the team communicated with the patient (yes). If there was no evidence of communication between each provider and the patient, then it was determined that not all of the team members communicated with the patient on the day of discharge (no). Discrepancies between provider questionnaires were resolved by using the data from the provider who was last to complete the questionnaire.

**New day of discharge team.** Teams that have previous experience caring for a patient may have an increased understanding of the patient’s discharge plan. The new day of discharge team variable describes if the discharge team as either a “new discharge team” (there is at least one member of the discharge team who has not worked with this patient previously) or an “experienced discharge team” (all members of the discharge team have
cared for the patient being discharged for more than one day). Using the Provider Transition to Home Survey, provider participants reported how many (calendar) days they had worked with the patient. If the all providers had worked with the patient for more than one day, then the team was determined to be an experienced discharge team. If there was at least one member of the discharge team for whom it was their first day working with the patient, then the team was determined to be a new day of discharge team.

**Team perception of safety.** The individual provider’s perception of safety was collected using Global Patient Safety Grade from the provider demographic questionnaire. For each discharge event the individual provider’s perception of safety was aggregated to the team-level by averaging the RN, MD, and DC Global Safety Grade scores. The Global Patient Safety Grade was initially created as a quick index to capture safety climate (Sorra & Dryer, 2010). According to Klein and Kozlowski (2000), climates are examples of shared team properties or composition processes, suggesting that providers that work together should have a similar perception of safety. Therefore, the average of the individual team member scores of the Global Patient Safety Grade was used to create the team perception of safety variable. Interrater agreement ($r_{wrj}$) was calculated to evaluate if the aggregation from the individual to team level was appropriate (LeBreton & Senter, 2008).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Defined</th>
<th>Operationalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN Professional Experience</td>
<td>Discharge team RN’s number of years since graduation from professional school</td>
<td>Years</td>
</tr>
<tr>
<td>MD Professional Experience</td>
<td>Discharge team MD’s number of years since graduation from professional school</td>
<td>Years</td>
</tr>
<tr>
<td>DC Professional Experience</td>
<td>Discharge team DC’s number of years since graduation from professional school</td>
<td>Years</td>
</tr>
<tr>
<td>Team Level of Professional Experience</td>
<td>Team’s aggregated years of professional experience</td>
<td>Average of RN, MD, and DC number of years since graduation from professional school</td>
</tr>
<tr>
<td>Team Level of Hospital Experience</td>
<td>Team’s aggregated years of experience at the hospital</td>
<td>Average of RN, MD, and DC number of years at the hospital</td>
</tr>
<tr>
<td>RN Education</td>
<td>Education level of RN in the discharge team</td>
<td>ADN, BSN</td>
</tr>
<tr>
<td>DC Education</td>
<td>Education background of DC in the discharge team</td>
<td>ADN, BSN, MSN, MSW</td>
</tr>
<tr>
<td>MD Education</td>
<td>Education background of MD in the discharge team</td>
<td>MD, DO</td>
</tr>
<tr>
<td>Communication Quality</td>
<td>Team’s aggregated quality of communication on the day of discharge</td>
<td>Average of RN, MD, and DC score</td>
</tr>
<tr>
<td>Teamwork Quality</td>
<td>Team’s aggregated quality of teamwork on the day of discharge</td>
<td>Average of RN, MD, and DC score</td>
</tr>
<tr>
<td>Number of Float Staff</td>
<td>Number of providers who do not work on a dedicated unit that are on the discharge team</td>
<td>Numerical count</td>
</tr>
<tr>
<td>Team Communication</td>
<td>Presence of communication between on the discharge team providers on the day of discharge</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Team-patient Communication</td>
<td>All team members communicated directly with the patient on the day of hospital discharge</td>
<td>Yes/No</td>
</tr>
<tr>
<td>New Day of Discharge Team</td>
<td>All team members had previously worked with the patient prior to day of discharge</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Team Perception of Safety</td>
<td>Team’s aggregated score of safety</td>
<td>Average of RN, MD, and DC safety score</td>
</tr>
</tbody>
</table>
Team Processes (Independent Study Variables)

According to the IPO model, process describes members’ interactions directed toward task accomplishment, as well as how team inputs are transformed into the outcomes (Mathieu et al., 2008). For this study, the team processes of interest include the team’s Teamwork SMM and Taskwork SMM.

**Teamwork Shared Mental Model.** A team’s Teamwork SMM is defined as the discharge team’s shared knowledge of the team members (expertise, preferences, and strengths/weaknesses) and team interactions (roles/responsibilities, communication patterns, and level of support; Cooke, Salas, Cannon-Bowers, 2000). Millward and Jeffries’ (2001) Shared Mental Model Scale from the Team Survey© was used to assess the Teamwork Shared Mental Model of each discharge team on the patient’s day of hospital discharge. Using the results of the Shared Mental Model Scale, the content of Teamwork SMM (Aim 1A) and Teamwork SMM Convergence (Aim 1A) was determined (see Table 7).

**Shared Mental Model Scale.** The Shared Mental Models Scale was developed and tested to measure healthcare teams’ Teamwork SMMs (Millward & Jeffries, 2001; Delva & Jamieson, 2005). The 13-item Shared Mental Models Scale is an established unidimensional measure to determine provider’s teamwork IMM (Millward & Jeffries, 2001). For each discharge event, using a 7-point Likert scale ([strongly disagree][1] to [strongly agree][7]), the individual providers rated their agreement with five key teamwork aspects used while discharging the patient: roles/responsibilities, interdependencies, information source utilization, knowledge of team members, and utilization of team members’ knowledge, skills, and attitudes. Examples of rated statements related to team interactions include: if asked, I could explain all of the roles in the team and how they overlap; all team members are aware of where to go for information when they need it; I received useful information for the team before I request it; I am well aware of my other team member’s skills and abilities; all team members are clear about the overall goals of the team (Millward & Jeffries, 2001).

The wording of the questionnaire directions was modified to fit the team’s task of preparing the patient at hospital discharge. The Shared Mental Model Scale has negatively and positively worded items, so reverse scoring for the negative items was conducted before aggregating the items to obtain the total scale score. The Shared Mental Model Scale is scored by averaging all of the items for each individual provider. A higher score on the
Shared Mental Models Scale indicates the team has a higher understanding of team member roles and teamwork behaviors performed during the discharge process.

The validity and reliability of the Shared Mental Model Scale was previously supported by Millward and Jefferies (2001), as well as Devla and Jamieson (2005). To establish content validity, Millward and Jeffries (2001) aligned the scale with Cannon-Bowers et al.’s (1990) classic conceptualization of teamwork Shared Mental Models. Additionally, consults with healthcare providers, team experts, and preliminary empirical work was completed to establish the scales content validity (Millward & Jeffries, 2001). A factor analysis by Millward and Jaffries’ (2001) was used to identify four different scales within the Team Survey© and concluded that the Shared Mental Models Scale was a separate independent factor. The Shared Mental Models Scale has been shown to have high internal consistency (Cronbach’s $\alpha = 0.83, 0.78$ by Millward & Jeffries, 2001 and Delva & Jamieson, 2005, respectively). Millward and Jeffries (2001) found that the Shared Mental Model Scale was predictive of team performance, in that teams with lower Shared Mental Models Scale scores had lower team performance as rated by their manager. Permission to adapt and use this scale was obtained from Dr. Banks (Appendix C1).

**Taskwork Shared Mental Model.** Taskwork SMMS contain knowledge of the task situation (current status, expectations, and what needs to be done). The task situation for this study is the interprofessional team preparing the patient for hospital discharge, which was measured using the Weiss et al. (2013) Discharge Provider-Readiness for Hospital Discharge Scale/Short Form (DP-RHDS/SF). Using the results of the DP-RHDS/SF and PT-RHDS/SF, the content of the Taskwork SMM (Aim 1B, 2B), Taskwork SMM Convergence (Aim 1B, 2B), and Taskwork SMM Accuracy (Aim 2B) was determined.

**Discharge Provider-Readiness for Hospital Discharge Scale/Short Form (DP-RHDS/SF).** Weiss et al.’s (2013) DP-RHS/SF was used to assess each member of the discharge team’s perception of a patient’s readiness for hospital discharge. The 8-item DP-RHDS/SF was used to assess each provider’s taskwork IMM (Weiss et al., 2013). For each discharge event, using an 11-point Likert scale (none [0] to totally [10]), the individual providers rated their understanding of how ready the patient was to be discharged. The DP-RHDS/SF assess four key aspects of readiness: 1) Personal Status, physical-emotional state of the patient prior to discharge; 2) Knowledge, perceived adequacy of information needed to respond to common concerns/problems in the post-hospitalization period; 3) Coping
Ability, perceived ability of the patient to self-manage personal and health care needs after discharge; and 4) Expected Support, emotional and physical assistance expected to be available following discharge (Weiss et al., 2013). An overall unidimensional score for the DP-RHDS/SF for individual providers was calculated using a summated total scale score from each provider.

The DP-RHDS/SF is a modification of the Nurse-Readiness for Hospital Discharge Scale/Short Form and MD-Readiness for Hospital Discharge Scale/Short Form, which uses “provider types” instead of nurse-specific or physician-specific wording. The RN-RHDS/SF has shown high internal consistency reliability (Cronbach $\alpha = .75-.83$), and nurse assessment of low discharge readiness was associated with a six- to nine-fold increase in readmission risk (Weiss et al., 2013; Weiss, Yakusheva, & Bobay, 2011). The MD-RHDS/SF has previously demonstrated high internal consistency reliability with a Cronbach’s $\alpha$ of 0.83 (Weiss, personal communication, 2015). Permission to adapt and use this scale was obtained from Dr. Marianne Weiss (the author and owner) (Appendix C2).

**Taskwork SMM Accuracy.** For each discharge event, the accuracy of the team Taskwork SMM was determined by subtracting the Taskwork SMM scores from the PT-RHDS/SF score for the associated patient. The absolute value of the difference between the patient and team was used, indicating that discharge events with scores closer to 0 were more accurate.

**Patient Readiness for Hospital Discharge Scale/Short Form (PT-RHDS/SF).** Weiss et al.’s (2013) 8-item PT-RHDS/SF was used to assess the patient’s self-perception of readiness for discharge to determine accuracy of the providers’ Taskwork SMM. This well-established unidimensional scale uses an 11-point summated rating scale to assess the following dimensions of discharge readiness: 1) Personal Status, 2) Knowledge, 3) Coping Ability, and 4) Expected Support (Weiss, et al., 2013). The PT-RHDS/SF is the basis for the DP-RHDS/SF, and reflects patient perceptions of readiness for hospital discharge (Weiss, et al., 2013).

The content of the original patient Readiness for Hospital Discharge Scale (RHDS) was derived from the literature, extensive focus groups with expert panels of nurses, and confirmatory factor analysis (Weiss & Piacentine, 2006). Predicative validity assessments for adult medical surgical patients found that lower RHDS scores were predicative of greater post-discharge coping difficulty (Weiss & Piacentine, 2006) and that greater readiness for
discharge was predictive of fewer 30-day hospital readmissions (Weiss et al., 2007). Previously the PT-RHDS/SF explained 93% of scale variance from the PT-RHDS, and the PT-RHDS/SF shows good internal consistency (Cronbach’s $\alpha = 0.79$; Weiss et al., 2013). The PT-RHDS/SF was used to determine Taskwork SMM Accuracy.

Table 7
Summary Linking the Team Process Variable to the Study Aim, Instrument, and Level of Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aim</th>
<th>Description</th>
<th>Instrument</th>
<th>Level of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM</td>
<td>1A,</td>
<td>Degree to which the team understands and uses members appropriately</td>
<td>Shared Mental Models Scale</td>
<td>Team – Aggregate score of the RN, MD, DC</td>
</tr>
<tr>
<td>Convergence</td>
<td>2A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork SMM</td>
<td>1A,</td>
<td>Degree of agreement among the team member responses on the Shared Mental Model scale</td>
<td>Shared Mental Model Scale</td>
<td>Team – Interrater agreement score of the RN, MD, DC</td>
</tr>
<tr>
<td>Convergence</td>
<td>2A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taskwork SMM</td>
<td>1B,</td>
<td>Provider (RN, MD, DC) shared perception of patient readiness for hospital discharge</td>
<td>DP-RHDS/SF</td>
<td>Team – Aggregate score of the RN, MD, DC</td>
</tr>
<tr>
<td>Convergence</td>
<td>2B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy of Taskwork SMM</td>
<td>2B</td>
<td>Difference between the team’s Taskwork SMM score and patient’s Taskwork SMM score</td>
<td>DP-RHDS/SF and PT-RHDS/SF</td>
<td>The difference between the team and patient’s scores</td>
</tr>
</tbody>
</table>

Output (Outcome Variables)

Outputs are the result of the team’s activities and include the performance and members’ affective reactions (Mathieu et al., 2008). There are two patient post-hospitalization outcomes for this study: quality of transition and utilization of unplanned medical services.

Quality of Transition. The quality of transition home is one of the patient post-hospitalization outcomes for Aim 2. Thirty days after hospital discharge, the Care Transitional Measure (CTM-15) was used to assess the patient’s perceptions of the quality of transition to home (Aim 2A, 2B).
Care Transitional Measure (CTM-15). The 15-item CTM-15 was used to assess the patient’s perception of quality of transition home, a patient-centered discharge outcome associated with fewer readmissions (Coleman et al., 2005; Goldstein, et al., 2016). This well-established questionnaire is a unidimensional measure of the quality of the post-hospital care transition experience from the patient’s perspective. The CTM-15 assesses the quality of hospital discharge including, critical understanding, respect for individual differences, preparation for self-management, and written care plan (Coleman et al., 2005). Participants responded on a 4-point scale: strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The scale is scored by using a linear transformation of the mean score of all the responses answered to a 100-point scale, with the lowest score being a 0 and the highest score is a 100 (Coleman et al., 2005). Higher scores are associated with higher quality of patient transitions (Coleman et al., 2005).

The CTM-15 has been used to examine the quality of transition home in a wide range of patient populations (Parry et al., 2008; Anatchkova et al., 2014; Bakshi et al., 2012). Coleman et al. (2005) examined the CTM-15’s construct validity by comparing patients who are and are not readmitted to the hospital and found that the CTM-15 could discriminate patients who had an ED visit or re-hospitalization from those who did not. Additionally, the appropriate scores converged with patient reports of negative experiences after post-hospitalization (Coleman et al., 2005). CTM-15 has previously been shown to have high internal consistency (Cronbach’s \( \alpha = 0.93 \); Coleman et al., 2005).

Utilization of Unplanned Medical Services. The second outcome for Aim 2 is 30-day utilization of unplanned medical services. Thirty days after hospital discharge, the patients self-reported in the follow-up interview/questionnaire if they had an unplanned readmission and/or unplanned ED visit (yes/no; Aim 2A, 2B). Utilization of unplanned medical services included patients who had passed away in the 30-day period if applicable.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Operationalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of transition</td>
<td>Measure of the quality of the post-hospital care transition experiences from the patient’s perspective</td>
<td>Care Transition Measure (CTM-15)</td>
</tr>
<tr>
<td>Utilization of unplanned medical services</td>
<td>Unplanned readmission and/or unplanned ED</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
Procedures

The study procedures included four phases: provider pre-recruitment; patient identification, screening, and consent; day of discharge enrollment and data collection; and patient follow-up data collection. An overview of the study procedures is presented in the following sections.

**Phase 1: Provider Pre-Recruitment**

Pre-recruitment of potentially eligible providers occurred over the month of January in 2017. Prior to enrolling discharge events, potentially eligible RNs, DCs, and MDs received information about the study using multiple recruitment methods. Informational posters were hung in staff break rooms and bathrooms (Appendix D1). An email that described the study and invited staff to participate was sent to all staff who could potentially be involved in a discharge event (Appendix D2). Over a month period, eleven presentations were given to inform the various provider types about the study. For example, presentations at the orthopedic clinic, cardiology clinic, and quarterly hospitalist meeting were used to recruit MDs. The DCs received a presentation at their monthly staff meeting. The nursing staff from each unit received multiple presentations about the study during morning huddles. The presentations included information about the study purpose and level of participation, as

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**Figure 6. Overview of the study procedures**

**Phase 1: Provider Pre-Recruitment**
- 1 month prior to data collection
- Recruited providers
  - Presentations
  - Email
  - Posters
- Interested providers
  - Received waiver of consent letter
  - Completed provider demographic survey

**Phase 2: Patient Identification, Screening, & Consent**
- 1-2 days prior to patient’s expected day of discharge
- Charge nurse identified patients
- Patient screening
  - Screening survey
  - SF-MSQ
  - Informed consent

**Phase 3: Enrollment & Data Collection**
- Day of discharge
- Discharge team enrollment
- Patient survey
- Demographics
- RHDS
- Provider survey
- Team characteristics
- DP-RHDS/SF
- Shared Mental Model Scale

**Phase 4: Patient Follow-up Data Collection**
- 30-days post-discharge
- Patient follow-up phone or mailed survey
- CTM-15 Scale
- Utilization of unplanned services
as well as an explanation that their participation was voluntary. Interested providers received a waiver of consent (Appendix E1) and were given the option to complete the provider demographic questionnaire (Appendix F1).

**Phase 2: Patient Identification, Screening, and Consent**

**Patient identification.** Patient recruitment occurred over an eight-month period (February 2017 to October 2017). Efforts were taken to identify potentially eligible patient participants at least 24 hours prior to hospital discharge. Recruiting patients prior to the day of hospital discharge provided patients with additional time to consider study participation, as well as minimize the amount of interference with patient care on the day of discharge. Identification of eligible patient participants began with the unit charge nurse. During recruitment weeks, Monday through Thursday, the charge nurse provided the researcher with a list of potentially eligible patients (those who were expected to discharge within 48-hours, as well as met the medical diagnosis, age, and home disposition inclusion criteria). Then, the researcher met with the identified patients to review a handout that explained the study procedures, risks, and benefits of participation in the study (Appendix D3).

**Patient screening.** If patients expressed interest in participating, a screening tool was administered to determine whether the prospective participant met all of the study eligibility criteria (Appendix F2). The screening tool verified that the patient was comfortable speaking English, lived at home prior to hospitalization, and expected to be discharged directly home without hospice or home health services. In addition, the Pfeiffer (1975) SPMSQ was administered to assess mental capacity. Patients were not eligible to participate if they received a score of seven or greater on the SPMSQ. There was an additional evaluation of informed consent process for patients who received a score of four or greater on the SPMSQ (Appendix E2). This process included asking the subject to name at least two things that they would be expected to do during the study, name the risks of the study, explain what the participant would need to do if they no longer wanted to participate, and explain what the participant would do if they experienced distress or comfort.

**Patient informed consent.** Eligible and interested patients received the informed consent document (Appendix E3). The researcher reviewed the document with the patients. Participants were encouraged to ask questions about the study, and were given time to review the informed consent document. To minimize coercion or undue influence, the principal investigator made it clear that participation was voluntary and in no way would
affect their clinical care. Interested patients signed the consent form, as well as a release of medical information form (Appendix E4). Patients were informed that their enrollment into the study was contingent on being discharge not on the weekend and still meeting the inclusion criteria on the day of hospital discharge.

**Phase 3: Day of Discharge Enrollment & Data Collection**

**Discharge team enrollment.** On the morning of the expected day of discharge, the patient’s discharge team (RN, MD and DC) was identified during the unit morning huddle. Provider’s willingness to participate was verified separately with the patient’s RN, DC, and MD. Providers, who had not previously received the waiver of consent, were given a copy at this time. The study procedures, risks, and benefits of the study were reviewed with each provider. Additionally, providers were given the opportunity to ask questions. If all providers and the patient agreed to participate and were eligible, then all four subjects were enrolled.

**Discharge team data collection.** Data collection from providers included the Provider Demographic Questionnaire (Appendix F1) and the Provider Transition to Home Survey (Appendix F4). The Provider Demographic Questionnaire was completed once, while the Provider Transition to Home Survey was completed by each provider on the discharge team for each discharge event. Providers were asked to complete the Provider Transition to Home Survey within three hours of the patient being discharged from the hospital. Prior to the end of the provider’s shift the researcher returned to the unit to collect the provider forms; if a provider needed additional time, they were given the option to return the questionnaire via a lock box on the unit. Using multiple modes of collection methods is a known retention strategy to maximize response rates (Grove et al., 2013).

**Patient day of discharge data collection.** Concurrently, on the morning the patient was expect to discharge from the hospital, the patient participants were asked to complete a paper version of the Patient Demographic Questionnaire (Appendix F3) prior to leaving the hospital. The patient’s questionnaire was either filled out with assistance from the researcher or completed individually by the patient. The questionnaire was retrieved from the patient approximately one hour prior to the expected time of discharge. Patient participants provided their home phone and/or cell phone, and their mailing address. Additionally, patients were asked to indicate if they preferred having the follow-up questionnaire completed by phone, mail, or by either approach. An effort was made to inform the patient of the date to expect the follow up interview, as well as that the interview
should take approximately 10 minutes: both strategies are shown to improve retention of subjects (Groves et al., 2013). Last, a review of the medical records was completed to collect the remaining patient characteristics within 24-hours of the patient discharge.

**Phase 4: Patient Follow-Up Data Collection**

Approximately 30 days after the patient was discharged, the patient was contacted to collect the CTM-15 and information regarding utilization of unplanned medical services. The method for the follow-up data collection depended on the patient’s preference (phone interview or mailed questionnaire). Patients received $10 in compensation after completing the Post-Discharge Patient Follow-up.

**Phone follow-up interview data collection.** The Post-Discharge Patient Follow-up Interview Guide (Appendix F6) was used to collect data via phone. Follow-up phone calls had a three-day call range: patients were contacted approximately 29 to 31 days from their day of hospital discharge. If the patient answered the phone call, after receiving the patient’s agreement to participate in the follow up interview, an effort was made to first gather data regarding utilization of unplanned medical services. Then, depending on the patient’s preference, they were given the option to complete the full questionnaire by a mailed paper questionnaire. This option was provided to patients for two reasons. First, many of the patients reported difficulty with hearing and talking on the phone. Second, many patients reported being busy and/or distracted because they were on their cell phone. Patients were called up to three times: if unable to reach the patient, a questionnaire was mailed to the patient.

**Mailed follow-up questionnaire data collection.** Patients that preferred to have their questionnaire mailed or were unable to be contacted by phone received a paper version of the Post-Discharge Patient Follow-up Questionnaire in the mail. A stamped returned envelope was provided. Patients had one week to return the mailed questionnaire.

**Data Management**

**Data Entry and Cleaning**

Data collected was entered into and stored electronically via the REDCap (Research Electric Data Capture) platform, and analyzed in the Statistical Analysis System (SAS) Studio Software. Prior to computer data entry, the paper questionnaires were visually scanned to identify missing data and potential problems. For example, all questionnaires were double-checked to ensure that the provider codes on the paper questionnaires matched the logbook.
To reduce the potential for errors a systematic plan that established rules for entering the data was created (Groves et al., 2013). Four undergraduate nursing students were involved in the data entry phase. Those involved with data entry were first familiarized with the questionnaires, and then were shown how to enter the data into REDCap. Each questionnaire was double-checked by a second individual to ensure data entry accuracy. Weekly meetings were held with the data entry team to identify potential problems and concerns.

Additionally, to identify potential data entry errors or missing data, appropriate range checks were programmed into the REDCap to prevent invalid values from being entered into the database. Electronic reports were run periodically to confirm correct values. Descriptive statistics, such as frequencies and measures of central tendency were performed to identify out-of-range values. Graphs (histograms and scatter plots) were used to identify potential outliers. The few identified errors were checked with the raw data for entry errors.

**Missing Data**

Missing data from surveys is a common problem for researchers. During entry and cleaning, the data from the 72 enrolled discharge events were checked for potentially missing values. Missing data is important to take into consideration because it is a possible source of bias that could impact the accuracy of results. Notably, Cohen and Cohen (1998) suggest that ten percent of missing data on one variable is considered small. There were no predictor variables with missing data that exceeded ten percent. The following section discusses how item non-responses were handled within this study, while Chapter 4 provides a more in-depth description on patient enrollment, response rate, and attrition.

**Patient item non-responses.** Of the 64 completed discharge events, there were two patient participants from two discharge events who were missing a single item from the CTM-15. Missing items for the CTM-15 is naturally handled via the scoring system, which takes the mean score of the total number of questions answered (Coleman et al., 2005).

**Provider item non-responses.** There was a total of eight discharge events that had provider item non-responses. There were three providers who were missing an item from the DP-RHDS. Additionally, there were two provider participants who were missing individual items for the Shared Mental Model scale, as well as three providers who were missing four items (out of 13 items) on the Shared Mental Model scale. A mean approach to
imputation (mean score from the providers responses on the other questions) was used for these participants.

**Imputation considerations.** The goal of the approaches taken to handle missing value was to keep in as many cases as possible for each step of analysis. However, there are some disadvantages of using imputation for missing data. For example, when mean imputation is used there is a potential that there will be a reduction in variability, which may weaken covariance and correlation estimates in the data (Wilson & Luek, 2014). Observations that were missing a provider's response or a large portion of the questionnaires were excluded. Chapter 4 discusses the total non-responses for the patient outcome variables.

**Analysis**

**Descriptive Statistics**

Descriptive statistics were calculated for all variables using means, medians, modes, ranges, interquartile ranges, and standard deviations for continuous variables, as well as frequencies and percentages for categorical variables. Patient, provider, and discharge team characteristics were evaluated and compared across inpatient units. ANOVA tests were used to examine continuous variables, whereas Chi-Square tests were used to examine categorical variables.

**Aim 1 Analysis**

The focus for Aim 1 was to describe the degree of convergence for discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units. The research questions include:

- **Question 1A.** What are the teams’ average Teamwork SMM and Teamwork SMM Convergence scores among the members’ individual mental models at the time of patient discharge?
- **Question 1B.** What are the teams’ average Taskwork SMM and Taskwork SMM convergence scores among the members’ individual mental models at the time of patient discharge?
- **Question 1C.** Is there a difference among the inpatient units mean scores for a) Teamwork SMMs, b) Teamwork SMM Convergence, c) Taskwork SMMs, and/or Taskwork SMM Convergence?
Average Teamwork and Taskwork SMM content scores. Klein and Kozlowski (2000) suggest using the average of individual scores to aggregate the content of SMMs to a team-level property. For each team, the providers’ individual scores on the Shared Mental Models Scale was averaged to determine a team’s average Teamwork SMM content score (Aim 1A). Teams that have a higher average Teamwork SMMs represent higher team-reported quality of Teamwork SMMs. Similarly, to determine the team’s average Taskwork SMM (Aim 1B), the individual providers’ scores on the DP-RHDS/SF was averaged together. Higher averages of Taskwork SMM score indicates that the team perceived the patient as being more prepared for hospital discharge.

Degree of convergence of Teamwork and Taskwork SMMs. To determine the degree of convergence of Teamwork SMM for each team (Aim 1A), an interrater agreement index ($r_{wg(j)}^*$) was calculated from the provider scores on the Shared Mental Models Scale. Likewise, to determine the Taskwork SMM Convergence of each team (Aim 1B), an $r_{wg(j)}^*$ was calculated from the providers scores on the DP-RHDS/SF. Interrater agreement is defined as “the extent to which the different judges tend to make exactly the same judgements about the rated subject” (Tinsley & Weiss, 1975, p. 359). There are several known approaches to measuring interrater agreement (O’Neill, 2017): Lindell et al.’s (1999) $r_{wg(j)}^*$ index (Equation 1) for calculating interrater agreement was used. The $r_{wg(j)}^*$ index determines the amount of overlap between individual providers’ responses to a questionnaire question by creating a comparison between the observed variance in ratings to the variances of a null distribution (a theoretical distribution representing maximum dissensus; Webber et al., 2000). Lindell et al.’s (1999) interrater agreement equation is as follows:

$$r_{wg(j)}^* = 1 - \frac{S_x^2}{\sigma_{mv}^2}$$

where $J$ is the number of scale items, $S_x^2$ is the mean observed variance in rating on $J$ items, and $\sigma_{mv}^2$ is variance of a null with maximum possible disagreement (Equation 2).

The variance of a null distribution with maximum possible disagreement is as follows:

$$\sigma_{mv}^2 = 0.5 \left( X_u^2 + X_L^2 \right) - [0.5(X_u - X_L)]^2$$

where $X_u$ and $X_L$ are the upper and lower discrete Likert categories. Maximum dissensus occurs when all judges are distributed evenly at the scale endpoints. When using the variance of a null distribution with maximum possible disagreement values, $r_{wg(j)}^*$ and $r_{wg(j)}^*$ range from 0
to 1.0; where the value of 1 is complete agreement; 0.5 indicates agreement equal to uniform null distributions; and 0 indicates theoretical maximum disagreement (Webber et al., 2000).

Strengths of using $r^{\text{wg}}$ is that this approach circumvents problems with inadmissible values (Lindell, Brandt, & Whitney, 1999; O’Neill, 2017; Webber, Chen, Payne, Marsh, & Zaccaro, 2000), allows for meaningful interpretation for values when the mean observed variance exceeds the variance of a null distribution with maximum possible disagreement (O’Neill, 2017; Webber et al., 2000), and is scale invariant which makes it comparable across different response scales or samples (Webber et al., 2000).

Unit Relationship Analysis. To answer Aim 1C separate ANOVA were conducted to determine if the mean scores of Teamwork SMMs, Teamwork SMMs, Teamwork SMM Convergence, and Taskwork SMMs Convergence differed by inpatient unit type.

Aim 2 Analysis

The second aim of the study was to determine the relationship between discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units and patient 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services) while controlling for contextual unit and patient characteristics. The research questions include:

- **Question 2A.** After controlling for contextual unit and patient characteristics, is there a relationship between Teamwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); if so, is that relationship modified by the i) degree of teamwork SMM convergence?

- **Question 2B.** After controlling for contextual unit and patient characteristics, is there a relationship between Taskwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); if so, is that relationship modified by i) the degree of Taskwork SMM convergence and/or ii) Taskwork accuracy?

Relationship analysis. Regression models were used to examine the relationship between SMMs (teamwork and taskwork) and patient post-hospitalization outcomes (Aim 2). Regression is used to find the model that best predicts the dependent variable from the independent variables (Konishi & Kitagawa, 2008; Kadane & Lazar, 2004). The independent variable of interest for Aim 2A was the discharge teams’ Teamwork SMM, while the independent variable of interest for Aim 2B was the discharge teams’ Taskwork SMM. Two regression models were developed based off of the patient outcomes: the quality of
transition (CTM-15) and utilization of unplanned medical services. In addition, this study examined several potential covariates (patient, team, and unit characteristics), many of which have been used in previous studies examining predictors of poor transition from the hospital to home (see Tables 4 and 6).

Figure 7 provides an overview of the three critical steps used in regression relationship analysis for Aim 2. The three steps include the modeling selection process (evaluating individual variables for appropriateness, key covariate predictor selection, and modified stepwise selection), model diagnostics (testing model assumptions and evaluation of goodness of fit), and model testing (regression analysis and interaction evaluation).

**Model Selection Process**
- Variable Evaluation for Appropriateness
  - Continuous Variables
  - Categorical Variables
- Key Covariate Predictor Selection
  - Literature review identified 9 key covariate predictors
  - Regression analysis to identify relationship between key predictors and outcome
  - Significant covariate variables are considered key predictors
- Modified Stepwise Model Selection
  - After forcing-in key predictor variables, use AIC to select additional predictors

**Model Diagnostics**
- Model Assumptions and Fit Evaluation
  - Quality of Transition
    - Examples: cumulative function plots, Kolmogorov-Smirnov test, Q-Q plot, Shapiro-Wilk's test, residuals vs. predicted plots, Cook's Distance, DFBETAS
  - Unplanned Utilization
    - Examples: ROC Curve, Hosmer-Lemeshow goodness of fit test, DFBETAS statistics and plots, Person's residuals vs deviance residuals, DFBETAS plots, collinearity diagnostics

**Model Testing**
- Regression Analysis
  - Quality of Transition
    - Multiple linear regression used to determine relationships between Teamwork and Taskwork SMIs and the CTM-15 (Aim 2a, 2b)
    - Test: Interactions of Teamwork SMIs, Taskwork SMIs, and Teamwork Accuracy (Aim 2a, 2b)
  - Unplanned Utilization
    - Logistic regression used to determine relationships between Teamwork and Taskwork SMIs, and the unplanned utilization (Aim 2a, 2b)
    - Test: Interactions of Teamwork SMIs, Taskwork SMIs, and Taskwork Accuracy (Aim 2a, 2b)

**Results in Aim 2 Findings**

*Figure 7. Overview of the Relationship Analysis for Aim 2. *This step was only completed for the Quality of Transition Model.*

**Overview of model selection.** The purpose of statistical modeling is to construct a model that “approximates the true structure as accurately as possible through the use of available data” (Konishi & Kitagawa, 2008, p. 1). A vital component of statistical modeling is variable selection. The goal of variable selection is to make a parsimonious model: one that balances model simplicity (fewest variables as possible) with model fit (as many variables that
conform to the data at hand; Konishi & Kitagawa, 2008). Optimized models result from controlling the variability associated with overfitting (unnecessarily complex due to extraneous explanatory variables), while also protecting against the bias associated with underfitting (too simplistic due to excluded variables; Konishi & Kitagawa, 2008). Model selection involved a modified stepwise analysis, including selection and testing of key covariates, followed by an Akaike Information Criterion corrected (AICc) stepwise selection of additional covariates. However the first step to reduce the number of variables in the model involved individually evaluating each variable for appropriateness of inclusion (see Figure 7).

**Variable evaluation for inclusion appropriateness.** As presented in Chapter 2, a significant amount of research has been completed to identify patient and system-level factors that affect patient’s readiness for hospital discharge, quality of transition home, as well as risk for hospital readmission and unplanned utilization of medical services. To examine the relationship between the discharge teams’ SMMs and patient’s post-hospitalization outcomes an initial 37 variables (patient, discharge team, and unit characteristics) were considered for inclusion in the regression model.

Preliminary analysis and variable screening is crucial for sound regression modeling practices (Greenland & Pearce, 2015). Descriptive analyses were used to identify the distribution of demographics of interest. The continuous variables were examined for collinearity using Person Correlations and Variance Inflation Factors. Continuous variables were evaluated for distribution normality. Additionally key variables were centered. Fisher exact chi-square tests were used to determine significance of categorical variables to the outcomes. The categorical variables were also evaluated to determine if categories needed to be collapsed or excluded due to limited observations.

**Continuous variable consideration.** Multicollinearity exists “whenever an independent variable is highly correlated with one or more of the other independent variables in a multiple regression equation” (Allen, 2007, p. 99). When independent variables are highly correlated then they will have a relatively large standard error and create unstable regression models (Allen, 2007). Additionally, if the independent variables are highly intercorrelated then the variables are redundant, fail to add new information to the model, and instead increase the degrees of freedom which makes it more challenging to reject the null hypothesis (Polit & Beck, 2010). Collinearity of continuous variables were examined
using two different methods: Pearson Correlations and Variance Inflation Factor (VIF). Pearson correlations were used to assess correlations between study variables, while VIFs were used to estimate how much the variance of a regression coefficient is inflated due to multicollinearity in the model. A bivariate Pearson Correlation of .8 or greater, and a VIF above 10, indicates high correlation and were re-examined for appropriateness of inclusion in the model (Rawlings et al., 1998). Last, in order to facilitate interpretation, several variables were centered using a deviation from the mean approach and then both the bivariate correlations and VIFs were re-examined for potential multicollinearity (Belsley, 1984).

**Categorical variable consideration.** Although information can be lost by collapsing variables categories, it is a routine practice when performing multivariable regression. Collapsing categorical predictors is a useful strategy to achieve parsimony while maintaining predictive power (Rawlings et al., 1998; Kadane & Lazar, 2004; Greenland & Pearce, 2015). Frequency tables and histograms were used to evaluate the necessity of collapsing categorical variables. Additionally, bivariate relationships between categorical variables and inpatient unit were examined in order to identify potential interdependence between variables or variables that had missing observations in a cell. Tables 4 and 6 indicate the final categories used in the analysis.

After evaluating variables for appropriateness of inclusion there were a total of 29 predictor variables (14 patient characteristics, 12 team characteristics, 3 team processes, as well as inpatient unit type) that were used in the model selection process.

**Modified stepwise analysis.** When there are a large number of potential explanatory variables, automatic variable algorithms - such as the stepwise regression procedure - are particularly helpful to identify the best fitting model (Konishi & Kitagawa, 2008; Kadane & Lazar, 2004). An advantage of using stepwise selection over forward or backwards methods is that the stepwise procedure checks more potential subset models prior to model selection, thus increasing the chance of selecting the best (although not guaranteed) subset model for the sample data (Rawlings, Pantula, & Dickey, 1998). However, there are also some potential drawbacks to using stepwise procedure (Rawlings et al., 1998; Steyerberg, Marinus, Eijkemans, Harrell, & Habbema, 2001). As Rawlings et al. (1998) warns, “no variable selection procedure can substitute for the insight of the researcher” (p. 205). Criticisms of using stepwise procedure for variable section include
instability of selection of predators, overestimation of regression coefficients, and a loss of predictive information in the model (Steyerberg et al., 2001). To protect against these potential pitfalls, a modified stepwise process was used to identify and incorporate theoretically and clinically important variables into the model.

Key covariate predictor selection. One of the challenges of using the stepwise procedure is that the automatic variable selection algorithms do not take into consideration prior clinical knowledge or information concerning the effects of factors (Greenland & Pearce, 2015; Kadane & Lazar, 2004; Steyerberg et al., 2001). However, prior knowledge and theory can be used to ensure that relevant variables that are selected a priori can be forced-in to the model (Greenland & Pearce, 2015; Kadane & Lazar, 2004). Variables that are forced-in are entered into the initial model and are not subject to deletion during the stepwise selection procedure (Greenland, 1989). The key covariate predictor selection process varied by patient post-hospitalization outcome.

Quality of Transition Pre-Selection Model. A total of 9 variables were considered as potential key covariate predictors to be forced in (modify) the stepwise selection process. Six patient characteristics variables were identified a priori from the literature as key variables to include when examining the relationship between patient characteristics and outcomes related to the hospital to home transition (Krumholz et al., 2013; Ross et al., 2008). These variables included patient age, principal diagnosis, gender, length of stay, number of comorbidities, and inpatient unit type. In addition, the three primary variables of interest (Teamwork SMMs, Taskwork SMMs, and Taskwork Accuracy) were included in the analysis. Although Teamwork SMM Convergence and Taskwork SMM Convergence were variables of interest, these variables were analyzed during the interaction testing step.

Then, to reduce the number of covariate predictors forced into the model during the stepwise procedure, a preliminary linear regression model (using the PROC GENMOD statement in SAS Studio) was used to test the relationship between the quality of transition outcome and the nine key variables that were chosen a priori on clinical/theoretical grounds. The variables that were significant for the preliminary linear regression model (Teamwork SMM, Taskwork SMM, inpatient unit type, principal diagnosis, patient age, and number of comorbidities) were forced into the stepwise selection process for the Quality of Transition Model and were not subject to deletion during the AICc selection procedure.
Unplanned Utilization of Medical Services Pre-Selection Model. Due to the limited sample size of the unplanned utilization of medical services outcome, only three variables of interest (Teamwork SMM, Taskwork SMM, inpatient unit) were considered as key variables. The relationship between the unplanned utilization of medical services outcome and the three variables of interests (Teamwork SMM, Taskwork SMM, and inpatient unit) was examined using the SAS LOGISTIC statement. These three variables were not subject to deletion during the AICc selection procedure.

Stepwise analysis. After selecting the key covariate predictor variables, a stepwise analysis was performed. Stepwise regression in SAS Studio is a variation of the forward selection technique: the model starts with no effects, and then adds/removes effects one-step at a time, until no more can be added or removed according to the stepwise criteria (Kadane & Lazar, 2004; SAS Institute, 2017). A critical component of the stepwise selection procedure is the model selection criterion. The model selection criterion is a measure that assesses the propriety of a fitted model by gauging how well the model balances the competing objectives of conformity to the data and parsimony (Kadane & Lazar, 2004). There are several different model selection criteria such as residual mean square, Bayesian Information Criterion, Akaike Information Criterion (AIC), and AICc. In the majority of cases, the smaller the value of the criterion, the better the fitted model balances these objectives.

The corrected version of AIC (AICc) was used in this study. AIC was derived as an estimator of the expected Kullback-Leibler information, which is a measure of separation between the fitted candidate model and the “true” model (the model that presumably generated the data; Greenland, 1989). AIC and AICc included a penalty for increasing the number of parameters in the model; therefore using this approach has tradeoffs of precision of fit with the number of parameters used to obtain the model fit (Rawlings et al., 1998; Kadane & Lazar, 2004). AICc is a corrected version that is used in studies with smaller sample sizes and is also considered as a moderately conservative selection criteria (has a moderate penalty during selection; Kadane & Lazar, 2004). A modified AICc stepwise procedure was used to develop a linear regression model for the quality of care transition outcome, and a logistic model for the utilization of unplanned medical services outcome. A similar modeling procedure was used to develop both the Quality Care Transition Model and Unplanned Utilization of Medical Services Models.
Quality of Transition stepwise analysis. A stepwise approach in SAS Studio with the PROC GLMSELECT STEPWISE AICC selection statement was used to identify a subset model for the sample data. In addition to the 6 forced-in variables, the pool of variables to select from included 14 patient variables (gender, marital status, housing type, household occupancy, educational attainment, employment status, insurance payer, number of recent hospitalizations, number of recent ED visits, length of stay, number of discharge medications, level of cognition, coping ability, and expected support), as well as 8 discharge team variables (team-level of professional experience, RN education, communication quality, number of float staff, team communication, team-patient communication, new day of discharge team, team perception of safety). The model with the smallest AICc value was considered the best fitting model (Kadane & Lazar, 2004). The model with selected variables using the stepwise procedure was labeled as the “Baseline Quality of Transition Model” (no interactions or nonlinear transformations).

Unplanned Utilization of Medical Services stepwise analysis. An AICc stepwise approach in SAS with the PROC HPGENSELECT, BINOMIAL distribution, LOGIT link, and STEPWISE AICC selection method statement was used to identify a subset model for the sample data of the utilization of unplanned medical services outcome. Due to the limited sample size of the utilization of unplanned medical services outcome, only three variables of interest (Teamwork SMM, Taskwork SMM, inpatient unit) were forced into the AICc stepwise selection process. The pool of patient and team level variables to select from were identical to the Quality of Transition Model. Again, the model with the smallest AICc value used to determine the best fitting mode (Kadane & Lazar, 2004). The model with selected variables using the stepwise procedure was labeled as the “Baseline Utilization of Unplanned Medical Services Model” (no variable transformations or interaction terms).

Model diagnostics. After selecting the Baseline Models and before subsequent statistical analyses, the each model was checked for goodness of fit and violations assumptions underlying regression (Figure 7).

Quality of Transition Model evaluation of assumptions and fit. The Baseline Quality of Transition Model was assessed for the four principal assumptions (linearity, homoscedasticity, independence, and normality) underlying linear regression models (Allen, 2007; Rawlings et al., 1998; SAS Institute, 2017). Graphical and statistical methods were used for model diagnosis and to assess model fit. For example, cumulative function form plots
were used to assess the linearity of relationships between the dependent and independent variables (Lin et al., 2002; SAS Institute, 2018). The ASSESS statement SAS provides plots the cumulative sums of residuals by each continuous independent variable. Cumulative function form plots also provide a graphical and statistical method to assess the mean structures, functional forms of covariates, and link function of the model (Lin et al., 2002).

Additionally scatter plots of the residuals versus the predicted values, as well as the residuals versus the individual independent variables, were used to assess the linearity of the relationship between the dependent and independent variables, statistical independence of the errors, and homoscedasticity of the errors (SAS Institute, 2018). The normality of the error distribution was assessed using a normal probability plot, normal quantile plot of the residuals, and Kolmogorov-Smirnov statistical test for normality (SAS Institute, 2017). Last, Cook’s Distance Statistics (Cook’s D) and DFBETAs statistics were used as diagnostics for influential and leverage cases (SAS Institute, 2017; Rawlings et al., 1998). This resulted in Final Quality of Transition Model (appropriate variable transformations, but no interaction terms).

**Utilization of unplanned medical services evaluation of assumptions and fit.**

Logistic regression has fewer assumptions than linear regression. First is that the outcome must be binary, which is appropriate for this outcome as it compares those who utilize an unplanned medical service (1) to those who did not (0). Logistic regression assumptions include having no influential/outlier cases, having an absence of multicollinearity, an independence of error terms, and appropriate model fit (Polit, 2014). A receiver operating characteristic (ROC) curve was used to assess accurateness of the model. Hosmer-Leneshow test was used provide insight into the fit of the model by evaluating how well observed frequencies of predicted probabilities correspond to expected frequencies in an ideal model (Polit, 2014, p. 401). A non-significant value (p < .05) of the Hosmer-Leneshow test indicates that the model fits the data reasonably well; although for small sample size studies the test needs to be interpreted with caution (Polit, 2014). To examine the model for the presence of influential/outlier cases, Standardized Pearson’s residuals, as well as Delta-Beta, influential statistics and plots were used. The independence of error terms was assessed by using Lowes’s graphs continuous covariates and the log odds of the outcome variable. Last, similar to linear regression, logistic regression requires there to be minimal to no multicollinearity among the independent variables. In addition to the initial preliminary test,
collinearity diagnostics for the variables in the Utilization of Unplanned Medical Services Baseline Model were re-examined.

**Model testing.** After a model was selected and the model diagnostics were preformed, regression analyses were used to determine the relationships between SMMs (Teamwork and Taskwork) and the quality of transition and utilization of unplanned medical services outcomes (Aim 2). Standard regression analysis in SAS Studio using the PROC REG statements were used to analyze the relationship between Teamwork SMMs, as well as Taskwork SMMs, and the quality of transition outcome after controlling for patient characteristics (principal diagnosis, age, gender, marital status, employment status, number of comorbidities, number of admissions), team characteristics (new day of discharge team and team level of experience), and patient unit. Logistic regression analysis in SAS Studio using the PROC LOGISTIC statement was used analyze the relationship between Teamwork SMMs, as well as Taskwork SMMs, and the utilization of unplanned medical services outcome after controlling for a patient’s number of comorbidities, day of discharge team communication quality, and inpatient unit.

**Interaction testing.** An exploratory research question for Aim 2A and Aim 2B sought to examine if the relationships were modified by the Teamwork SMM Convergence, Taskwork SMM Convergence, and Taskwork Accuracy. Models with each interaction term were generated to test for a significant interaction between quality of transition and utilization of unplanned medical services. To examine if the SMM properties modified the relationship three interaction terms were created: Teamwork SMM Convergence x Teamwork SMM (Aim 2a), Taskwork SMM Convergence x Taskwork SMM (Aim 2b), and Taskwork Accuracy x Taskwork SMM (Aim 2b). To test for significance for each moderation effect, individual regression analyses that included the interaction terms were performed using SAS PROC REG for the Quality of Transition Model and PROC LOGISTIC for the Utilization of Unplanned Medical Services Model. An interaction term was considered to be significant if it had a significant $p$-value and lowered the AICc (i.e., lower values indicates a better fitting model). If interactions were appropriate, model diagnostics were re-evaluated.
Summary

In summary, the purpose of this prospective longitudinal pilot study was to examine the content of SMMs among inpatient discharge team members, and the influence of SMMs on patients’ post-hospitalization outcomes (quality of transition and utilization of unplanned medical services). This chapter included a description of the research method and design, a description of the sample, variables examined (Tables 4-6), study protocol (Figure 6), data management practices, and analyses. The next chapter provides the study results.
CHAPTER 4
RESULTS

The purpose of this prospective longitudinal pilot study was to examine the content of SMMs among inpatient discharge team members, and the influence of SMMs on patients’ post-hospitalization outcomes (quality of transition and utilization of unplanned medical services). This chapter presents the results of a prospective pilot study. The study was informed by the IPO model and Meleis’ transition theory. Descriptive and inferential statistics are presented first, followed by main statistical analyses to answer the research questions. Findings are presented in three main sections: study sample characteristics, results of Aim 1, and results of Aim 2. The last section provides an overview summary of the results found by aim. Appendix F contains the tools used in the study, and Appendix G includes additional results of interest.

Sample Description

Participation Enrollment, Response, and Attrition

Figure 8 provides a flowchart outlining the patient enrollment process. For patient screening and enrollment (study protocol stage 2, Figure 6), efforts were taken to identify potentially eligible patient participants at least 24 hours prior to hospital discharge. Data collection occurred over eight months. On data collection days, a total of 201 patients were identified by the charge nurse as potential participants expected to meet the medical diagnosis, age, and disposition inclusion criteria. These 201 patients were approached and further assessed using the screening tool. Following the initial pre-screening assessment, 51% (n = 103) were eligible and interested in participating in the study prior to the expected day of hospital discharge. Patients were screened again for eligibility on the day of expected discharge due to potential changes in the patient’s status and care plan, such as a change in disposition to a skilled nursing facility, or needing home health or hospice. Following the second eligibility screening (study protocol stage 3), 69.9% (n = 72) of the pre-screened patients were eligible to be enrolled. Being discharged on the weekend (17%; n = 17) was the primary exclusion reason for pre-screened patients. Then, because of patient and provider refusals (n = 4; 6% and n = 4; 6%, respectively), there were a total of 64 discharge events that were enrolled and fully completed on the day of hospital discharge.
Figure 8. Flowchart showing process of patient enrollment, response, and attrition.
The last stage of data collection involved following up with the patient (via phone call or mailed survey) to collect the utilization of unplanned medical services and quality of transition (CTM-15) outcomes. A total of six patient participants could not be contacted. The 30-day follow-up rates differed for the outcomes collected. During the follow-up phone call, and after receiving the patient’s agreement to participate in the follow-up interview, an effort was made to first ask the utilization of unplanned medical service question. Then, depending on the patient’s preference, the participant was given the option to complete the CTM-15 by a mailed paper questionnaire. This option was provided to patients for two reasons. First, many of the patients reported difficulty with hearing on the phone. Second, because the majority of participants were on their cell phone many patients reported being busy and/or distracted during the call (e.g., driving, at work, in the hospital). Of the 64 enrolled patients, 90% (n = 58) completed the utilization of unplanned medical service question, and 66% (n = 42) completed the questions for the Quality of Transition (CTM-15 scale).

**Sample Description: Patient**

Table 9 and Table 10 provide a summary of patient participant demographics. A total of 64 adult patients comprised the sample, including 22 Medical unit patients (Pneumonia n = 11; COPD n = 11), 21 Orthopedic unit patients (knee replacement n = 10; hip replacement n = 11), and 21 Cardiology unit patients (CHF n = 10; AMI n = 11). The participants were evenly split between males (n = 32) and females (n = 32) and ranged in age from 65 to 95 years old (Mean [M] = 75 years old, Standard Deviation [SD] = 7.7). The majority of participants were white (87.5%; n = 56), retired (73.4%; n = 47), with a high school education (n = 34; 53.1%). Over half reported to be married (n = 38; 59.4%). A majority of participants lived in their own home (92.2%; n = 59) and 53% lived with only one other person (n = 34). The sampled patients took 4 medications a day (SD = 5.8), and had a mean of 11 comorbidities (SD = 2.8) at time of discharge. The mean length of hospital stay was 3.9 days (SD = 1.7). The majority of patients had an unplanned hospital admission (n = 43; 67%) and were not admitted to the ICU during their hospitalization (n = 59; 92%). Patient participants reported a moderate level of expected support at home (measured with the RHDS Expected Support subscale; M = 6.8; SD = 3.6) and coping ability (measured with the RHDS Coping Ability subscale; M = 8.6, SD = 1.5). With 72% (n = 42) of patients scoring zero on the SPMSQ, the patient sample had a high level of cognitive functioning (M
Additionally, on average the patients reported having 1.7 hospital admissions ($SD = 1.1$) and 1.2 ED visits ($SD = 1.2$) over last 12 months. The patient sample demographics are comparable to the Mercy hospital patient population.

Chi-square goodness-of-fit and Fisher’s exact probability tests were used to determine whether the frequency of (nominal) patient characteristics were different across the inpatient units from what would be expected by chance. The level of significance ($\alpha$) was set at .05 for all analyses. As depicted in Table 9, the frequency of married and single participants differed across inpatient unit types, $\chi^2(2, N = 64) = 6.4, p = .036$. Of the Orthopedic unit patients, 81% were married ($n = 17$), which was a higher percentage compared to the Medical unit patients (54.6%; $n = 12$) and the Cardiology unit patients (43.9%; $n = 9$). The Orthopedic unit was also the only unit to have patients with a planned hospital admission ($n = 21$).

As shown in Table 10, ANOVA and Kruskal-Wallis tests were used to explore if there was a difference in the (continuous) patient characteristics across unit types. Using histograms and descriptive statistics, the distributions of the patient characteristics residuals were examined and 6 variables were determined to not have a normal distribution: length of stay and level of cognition were positively skewed, whereas the patient coping, expected support, number of admissions, and number of ED visit variables were negatively skewed. For variables with a non-normal distribution Kruskal-Wallis tests were used. Table 10 provides a summary of the ANOVA and Kruskal-Wallis tests results comparing the patient characteristics across inpatient unit types. Using Kruskal-Wallis test it was determined that the number of admissions, $\chi^2(2, N = 64) = 6.1, p < .047$ and number of ED visits, $\chi^2(2, N = 64) = 24.38, p < .001$. Additionally, the results from an ANOVA test showed a significant difference in patient’s age across the inpatient unit types, $F(2, 61) = 4.9, p = .011$. 

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Table 9
Summary of Frequency (and Percentages) for Patient Characteristics Overall and by Inpatient Unit Type

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Overall (N = 64)</th>
<th>Medical (n = 22)</th>
<th>Orthopedic (n = 21)</th>
<th>Cardiology (n = 21)</th>
<th>p^a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Medical</td>
<td>Orthopedic</td>
<td>Cardiology</td>
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<tr>
<td>Principal Diagnosis</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pneumonia</td>
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<td>COPD</td>
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<td>Knee Replacement</td>
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<td>Hip Replacement</td>
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<td>CHF</td>
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<td>AMI</td>
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<td></td>
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<td></td>
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<td>.720</td>
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<tr>
<td>Female</td>
<td>32 (50%)</td>
<td>10 (50%)</td>
<td>12 (57.1%)</td>
<td>10 (47.6%)</td>
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</tr>
<tr>
<td>Male</td>
<td>32 (50%)</td>
<td>10 (50%)</td>
<td>9 (41.9%)</td>
<td>11 (52.3%)</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
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<td>Non-white</td>
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<td>3 (14.3%)</td>
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<tr>
<td>White</td>
<td>56 (87.5%)</td>
<td>20 (90.9%)</td>
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<tr>
<td>Insurance Payer</td>
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<td>Medicare Only</td>
<td>17 (26.6%)</td>
<td>3 (13.6%)</td>
<td>9 (42.8%)</td>
<td>5 (23.8%)</td>
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</tr>
<tr>
<td>Medicaid and Medicare</td>
<td>8 (12.5%)</td>
<td>3 (13.6%)</td>
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<td>3 (14.3%)</td>
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</tr>
<tr>
<td>Private Only</td>
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<td>Private and Medicare</td>
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<td>16 (72%)</td>
<td>8 (38.1%)</td>
<td>12 (57.1%)</td>
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<td>Marital Status</td>
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<td>Married</td>
<td>38 (59.4%)</td>
<td>12 (54.6%)</td>
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<tr>
<td>Single</td>
<td>26 (40.6%)</td>
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<td>4 (19%)</td>
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<td>House/Apartment/Condo</td>
<td>59 (92.2%)</td>
<td>20 (90.9%)</td>
<td>21 (100%)</td>
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<tr>
<td>Independent Living</td>
<td>5 (7.8%)</td>
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Table 9 (Continued)

<table>
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<th>Patient Characteristic</th>
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<th>Unit Type</th>
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<tr>
<td></td>
<td>N (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
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<td>Household Occupancy</td>
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<tr>
<td>Lives Alone</td>
<td>22 (34.4%)</td>
<td>8 (35.4%)</td>
<td>4 (19%)</td>
<td>10 (47.6%)</td>
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<td>Lives with 1 Person</td>
<td>34 (53.1%)</td>
<td>11 (50%)</td>
<td>15 (71.4%)</td>
<td>8 (38.1%)</td>
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</tr>
<tr>
<td>Lives with 2+ People</td>
<td>8 (12.5%)</td>
<td>3 (12.6%)</td>
<td>2 (9.5%)</td>
<td>3 (15.3%)</td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>Educational Attainment</td>
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<td>Non-High School Graduate</td>
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<tr>
<td>High School Graduate</td>
<td>6 (9.4%)</td>
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<td>Some College or Higher Education</td>
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<td>14 (63.6%)</td>
<td>9 (42.9%)</td>
<td>11 (52.4%)</td>
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<td></td>
<td>.700</td>
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<td>Working</td>
<td>14 (21.9%)</td>
<td>5 (22.7%)</td>
<td>5 (23.8%)</td>
<td>4 (19.0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>47 (73.4%)</td>
<td>15 (68.2%)</td>
<td>16 (76.2%)</td>
<td>16 (76.2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed or Disabled</td>
<td>3 (4.7%)</td>
<td>2 (9.09%)</td>
<td>0</td>
<td>1 (4.8%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned Admission (Yes)</td>
<td>21 (32.8%)</td>
<td>0</td>
<td>21 (100%)</td>
<td>0</td>
<td>&lt;.001*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU Admission (Yes)</td>
<td>5 (7.8%)</td>
<td>3 (13.6%)</td>
<td>0</td>
<td>2 (9.5%)</td>
<td>.230</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. COPD = Chronic Obstructive Pulmonary Disease; CHF = Congestive Heart Failure; AMI = Acute Myocardial Infarction; ICU = Intensive Care Unit. Not all percentages add up to a hundred due to rounding. \(^a\) Two-tailed chi-square or Fisher’s exact test (used when expected frequencies were < 5) compared the frequency of patient characteristics across inpatient unit type. \(^*\) p <.05.
<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Total (N = 64)</th>
<th>Unit Type</th>
<th>(F_{(2, 61)}) a or (\chi^2(2)) b</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Medical (n = 22)</td>
<td>Orthopedic (n = 21)</td>
<td>Cardiology (n = 21)</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>M (SD)</td>
<td>75 (7.7)</td>
<td>74.4 (7.4)</td>
<td>72 (4.4)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>65/95</td>
<td>65/93</td>
<td>65/81</td>
</tr>
<tr>
<td>Length of Stay (Days)</td>
<td>M (SD)</td>
<td>3.9 (1.7)</td>
<td>4.7 (2.4)</td>
<td>3.4 (1.2)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>1/10</td>
<td>1/10</td>
<td>1/6</td>
</tr>
<tr>
<td>Number of Medications</td>
<td>M (SD)</td>
<td>3.8 (5.8)</td>
<td>11.4 (6.6)</td>
<td>11.9 (5.4)</td>
</tr>
<tr>
<td>Number of Comorbidities</td>
<td>M (SD)</td>
<td>5.2 (2.8)</td>
<td>5.2 (1.9)</td>
<td>4.2 (1.6)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>2/17</td>
<td>2/9</td>
<td>2/9</td>
</tr>
<tr>
<td>Level of Cognition (0-7)</td>
<td>M (SD)</td>
<td>0 (1)</td>
<td>0.7 (1.3)</td>
<td>0 (0.3)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>0/4</td>
<td>0/4</td>
<td>0/1</td>
</tr>
<tr>
<td>Coping Ability (0-10)</td>
<td>M (SD)</td>
<td>8.6 (1.5)</td>
<td>8.4 (1.6)</td>
<td>8.6 (1.5)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>5/10</td>
<td>5/10</td>
<td>5/10</td>
</tr>
<tr>
<td>Expected Support (0-10)</td>
<td>M (SD)</td>
<td>6.8 (3.6)</td>
<td>5.5 (4)</td>
<td>8.2 (2.8)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>0/10</td>
<td>0/10</td>
<td>0/10</td>
</tr>
<tr>
<td>Number of Admissions</td>
<td>M (SD)</td>
<td>1.7 (1.1)</td>
<td>1.9 (1.2)</td>
<td>1.2 (0.4)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>1/5</td>
<td>1/5</td>
<td>1/2</td>
</tr>
<tr>
<td>Number of ED Visits</td>
<td>M (SD)</td>
<td>1.2 (1.2)</td>
<td>1.9 (1.4)</td>
<td>0.4 (0.7)</td>
</tr>
<tr>
<td></td>
<td>Min/Max</td>
<td>0/5</td>
<td>1/5</td>
<td>0/3</td>
</tr>
</tbody>
</table>

**Note.** Level of Cognition was measured using the Short Portable Mental Status exam (ranges from 0 (intact) to 10 (severe)). RHDS subscales were used to measure coping ability which ranges from 1 (poor) to 10 (excellent), and expected support which ranges from 0 (none) to 10 (great deal). aANOVAs and Kruskal-Wallis b comparing patient characteristics by unit type. *p <.05.
Sample Description: Individual Provider

A summary of individual provider characteristics are shown in Table 11 and 12. There were 56 unique individual providers who participated in the 64 discharge events: 27 bedside nurses (RNs), 6 Discharge Coordinators (DCs), and 23 physicians (MDs). On average an individual provider participated in 3.4 discharge events (minimum participation = 1 time, maximum participation = 16 times). Individual provider characteristics were collected using the Provider Demographic Questionnaire and are not directly related to a specific discharge event. Below is a description of the provider sample by type. The study sample of providers was consistent with study hospital’s provider demographics. Notably, each discharge event had a unique inpatient team.

Nursing sample. The study included 27 unique individual RN participants. The majority of nurses sampled were female (96.3%; n = 26) with an Associate’s Degree in Nursing (ADN; 66.7%; n = 18). The average RN participant was 42 years old (SD = 12.4) with 12.1 years of nursing professional experience (SD = 9.8). The study sample included no float RNs. The majority of RNs indicated the hospital was doing very well at providing safe patient care (73%; n = 19).

Discharge Coordinator sample. A total of 6 individual DCs participated in the study. The mean age of the DC participants was 39 years old (SD = 11.4), and all were female. There was diversity in the DCs’ educational background: 2 had an ADN (33.3%), 2 had a Bachelor of Science in Nursing (BSN; 33.3%), and 2 had a Masters in Social Work (MSW; 33.3%). The majority (66.6%; n = 4) of DCs were assigned to a specific inpatient unit; only two DCs were assigned as floats (or staff who regularly provided cross-unit coverage). On average the participants had 4.7 years of professional experience as a DC (SD = 6.6), but 8.5 years (SD = 9) of experience working at the study hospital (SD = 9). A slight majority of DCs rated the hospital as excellent at providing safe patient care (55.7%; n = 4).

Physician sample. There were 23 unique individual physician participants. Unlike the RN and DC participants, 87% (n = 20) of MDs were male. Almost all of the MDs had their Medical Doctorate (MD; 95.7%; n = 22), with only one having their Doctorate in Osteopathic Medicine (DO; 4.3%). The physicians surveyed included the hospitalist team, who were considered float staff because they provided cross coverage to all inpatient units;
approximately 30% of the MDs participants were hospitalists (or floats; n = 7). The non-
hospitalist physicians were assigned to the units as follows: 17.4% were assigned to the
Medical unit (n = 4), 26% were assigned to the Orthopedic unit (n = 6), and 26% were
assigned to the Cardiology unit (n = 6). The mean age for the MD group was 49.8 years old
(SD = 11.9). Of the provider types, the MD group reported the highest level of professional
experience, with an average 17.6 years of professional experience (SD = 10.2) and 12.3 years
of hospital experience (SD = 10.8). Similar to the DCs, the majority of MDs reported the
hospital as excellent at providing safe care (66.7%; n = 14).
Table 11  
**An Overall and by Provider Type Summary of Frequency (and Percentage) of Unique Providers Sampled**

<table>
<thead>
<tr>
<th>Provider Characteristics</th>
<th>Overall (N = 56)</th>
<th>Nurse (n = 27)</th>
<th>Discharge Coordinator (n = 6)</th>
<th>Physician (n = 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>35 (62.5)</td>
<td>26 (96.3%)</td>
<td>6 (100%)</td>
<td>3 (13.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>21 (37.5)</td>
<td>1 (2.7%)</td>
<td>0</td>
<td>20 (87%)</td>
</tr>
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<td>Provider Education</td>
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</tr>
<tr>
<td>ADN</td>
<td>19 (33.9%)</td>
<td>18 (66.7%)</td>
<td>2 (33.3%)</td>
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<tr>
<td>BSN</td>
<td>12 (21.4%)</td>
<td>9 (33.3%)</td>
<td>2 (33.3%)</td>
<td>0</td>
</tr>
<tr>
<td>DO</td>
<td>1 (1.8%)</td>
<td>0</td>
<td>0</td>
<td>1 (4.3%)</td>
</tr>
<tr>
<td>MD</td>
<td>22 (39.3%)</td>
<td>0</td>
<td>0</td>
<td>22 (95.7%)</td>
</tr>
<tr>
<td>MSW</td>
<td>2 (3.6%)</td>
<td>0</td>
<td>2 (33.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Safety Perception</td>
<td></td>
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<td></td>
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<tr>
<td>Excellent</td>
<td>23 (43.4%)</td>
<td>5 (19.2%)</td>
<td>4 (66.7%)</td>
<td>14 (66.7%)</td>
</tr>
<tr>
<td>Very Good</td>
<td>28 (52.8%)</td>
<td>19 (73%)</td>
<td>2 (33.3%)</td>
<td>7 (33.3%)</td>
</tr>
<tr>
<td>Acceptable</td>
<td>2 (3.8%)</td>
<td>2 (7.7%)</td>
<td>0</td>
<td>0</td>
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<td>Poor</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Failing</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note. ADN = Associate’s Degree in Nursing; BSN = Bachelor of Science in Nursing; DO = Doctor of Osteopathy; MD = Doctor of Medicine; MSW = Master of Social Work. Not all percentages add up to a hundred due to rounding. Safety Perception was measured using the Global Safety Grade score (Sorra & Dryer, 2010)*
Table 12

*Overall and by Provider Type Summary of Mean (M), Standard Deviations (SD), and Minimum/Maximum values for Unique Provider Characteristics*

<table>
<thead>
<tr>
<th>Provider Characteristic</th>
<th>Overall</th>
<th>Provider Type</th>
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<th></th>
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</thead>
<tbody>
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<td></td>
<td>All Providers</td>
<td>Nurse</td>
<td>Discharge Coordinator</td>
<td>Physician</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N = 56)</td>
<td>(n = 27)</td>
<td>(n = 6)</td>
<td>(n = 23)</td>
<td></td>
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</tr>
<tr>
<td>Age (Years)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>M (SD)</td>
<td>44.9 (12.5)</td>
<td>42.3 (12.4)</td>
<td>39 (11.4)</td>
<td>49.8 (11.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>24/74</td>
<td>24/72</td>
<td>27/59</td>
<td>31/74</td>
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</tr>
<tr>
<td>Profession Experience (Years)</td>
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<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>12.1 (9.8)</td>
<td>9.0 (7.4)</td>
<td>4.7 (6.6)</td>
<td>17.6 (10.2)</td>
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</tr>
<tr>
<td>Min/Max</td>
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<td>0.4/25</td>
<td>1/18</td>
<td>1/41</td>
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<tr>
<td>Hospital Experience (Years)</td>
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</tr>
<tr>
<td>M (SD)</td>
<td>9.7 (9.35)</td>
<td>7.8 (7.8)</td>
<td>8.5 (9)</td>
<td>12.3 (10.8)</td>
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</tr>
<tr>
<td>Min/Max</td>
<td>0.3/41</td>
<td>0.3/25</td>
<td>1/25</td>
<td>1/41</td>
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</tr>
<tr>
<td>Unit Experience (Years)</td>
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</tr>
<tr>
<td>M (SD)</td>
<td>9.4 (10.4)</td>
<td>7.2 (7.5)</td>
<td>6.6 (10.3)</td>
<td>12.3 (10.8)</td>
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<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>0.3/41</td>
<td>0.3/25</td>
<td>1/25</td>
<td>1/41</td>
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</tbody>
</table>
Sample Description: Discharge Team

Tables 13 and 14 provide an overall summary, as well as a comparison by inpatient unit, of the team characteristics for the 64 discharge events. For the 64 completed discharge events, 40 (62.5%) events involved a discharge team nurse with an ADN degree. Twenty-six events had an ADN-prepared DC, 20 events involved a BSN-prepared DC, and 18 events involved an MSW-prepared DC (40.6%, 28%, and 28%, respectively). When examining individual providers on the discharge teams’ years of professional experience, on average the DC and RN had comparable years of professional experience ($M = 8.5$ and $M = 8.6$ years respectively), whereas the MD on average had more years of professional experience ($M = 16.8$ years). Additionally, for each discharge team, professional experience was aggregated to the team-level by averaging the RN, MD, and DC years of professional experience. The average team years of professional experience for each discharge event was 11.9 years ($SD = 5.7$). The majority of discharge events had evidence of all team members communicating with the patient on the day of hospital discharge (82.8%; $n = 53$). A little less than half of the discharge events had at least one new team member (or “new day of discharge team”) that did not have prior experience working with the patient (43.8%; $n = 28$). Lastly, only 59.4% had all members of the discharge team communicate together at least once on the day of discharge ($n = 38$).

Adapted measures from Millward and Jeffries (2001) Team Survey were used to determine communication quality and Teamwork Quality (ranging from 0 [poor] to 7 [excellent]). Although not all discharge teams communicated with the patient or among all team members on the day of discharge, the discharge team average scores for communication quality and teamwork quality were high ($M = 6.1$, $SD = 0.6$; $M = 6.2$, $SD = 0.7$, respectively). Similarly, for the discharge events sampled, the average team perception of hospital safety was a 4.3 out of 5 ($SD = 0.3$), which indicates that as a team the providers felt that the hospital does a very good job at providing safe patient care (Sorra & Dryer, 2010). The mean $r_{wg}$ for team communication quality ($r_{wg} M = .76$, $SD = .4$), teamwork quality ($r_{wgj} M = .79$, $SD = .3$), and perception of safety ($r_{wgj} M = .72$, $SD = .2$) variables for the discharge events indicates aggregation to the team-level is appropriate. An average $r_{wgj}$ of .7 or greater
indicates an appropriate level of agreement among individuals and is conventionally used to justify the aggregation to a team level property (Lance et al., 2006).

Chi-square goodness-of-fit and Fisher’s exact probability tests were used to determine whether the frequency of the discharge team nominal characteristics were different across inpatient units from what would be expected by chance. As shown in Table 13, the educational background of the DC on the team differed significantly by inpatient unit type ($p = <.001$).

ANOVA and Kruskal Wallace tests were used to examine if there was a difference in the discharge team continuous characteristics across inpatient unit types. Distribution plots of the discharge team characteristics residuals were visually examined to determine the distribution of the variable. Five variables were determined to not have a normal distribution: MD professional experience was negatively skewed, whereas RN professional experience, DC professional experience, communication quality, and teamwork quality were negatively skewed. For the variables with non-normal distributions, Kruskal Wallace test was used. Table 14 provides the results of these analysis. Discharge events from the Orthopedic unit had more professionally experienced nurses on the discharge team ($M = 15.4$ years; $SD = 5.5$) compared to the events from the Cardiology unit ($M = 5.3$ years; $SD = 4.2$) and the Medical unit ($M = 5.1$ years; $SD = 5.1$). Discharge events from the Medical unit had discharge team DCs with a mean of 1.7 years of professional experience ($SD = 0.5$), while the mean experience of DCs involved in events on the Orthopedic unit and Cardiology unit was greater ($M = 11.7$ years, $SD = 7.8$; and $M = 13.2$ years, $SD = 7.8$, respectively). The mean of the team years of professional experience also differed by inpatient unit type: the Orthopedic unit events had teams with the highest mean years of experience ($M = 16.4$ years; $SD = 4.1$) and the Medical unit had teams with the lowest mean years of experience ($M = 7.5$ years; $SD = 4.8$).
Table 13
An Overall and by Unit Type Summary of Frequency (and Percentages) for Team Characteristics of Discharge Events (N = 64)

<table>
<thead>
<tr>
<th>Team Characteristic</th>
<th>Overall</th>
<th></th>
<th>Unit Type</th>
<th></th>
<th>Chi-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>Total</td>
<td>Medical</td>
<td>Orthopedic</td>
<td>Cardiology</td>
</tr>
<tr>
<td>Unit Type</td>
<td></td>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>RN Education</td>
<td>64 (100%)</td>
<td>22 (34.4%)</td>
<td>21 (34.8%)</td>
<td>21 (34.8%)</td>
<td></td>
</tr>
<tr>
<td>ADN</td>
<td>40 (62.5%)</td>
<td>15 (68.2%)</td>
<td>15 (71.4%)</td>
<td>10 (47.6%)</td>
<td></td>
</tr>
<tr>
<td>BSN</td>
<td>24 (37.5%)</td>
<td>7 (31.4%)</td>
<td>6 (28.6)</td>
<td>11 (52.4%)</td>
<td></td>
</tr>
<tr>
<td>DC Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADN</td>
<td>26 (40.6%)</td>
<td>0</td>
<td>13 (61.9%)</td>
<td>13 (61.9%)</td>
<td></td>
</tr>
<tr>
<td>BSN</td>
<td>20 (31.3%)</td>
<td>14 (63.6%)</td>
<td>3 (14.3%)</td>
<td>3 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>MSW</td>
<td>18 (28%)</td>
<td>8 (36.4%)</td>
<td>5 (23.8%)</td>
<td>5 (23.8%)</td>
<td></td>
</tr>
<tr>
<td>Team Communication (Yes)</td>
<td>38 (59.4%)</td>
<td>16 (72.7%)</td>
<td>11 (52.4%)</td>
<td>11 (52.4%)</td>
<td>.290</td>
</tr>
<tr>
<td>Patient-Team Communication (Yes)</td>
<td>53 (82.8%)</td>
<td>18 (81.8%)</td>
<td>15 (71.4%)</td>
<td>20 (95%)</td>
<td>.256b</td>
</tr>
<tr>
<td>New Day of Discharge Team (Yes)</td>
<td>28 (43.8%)</td>
<td>8 (36.4%)</td>
<td>10 (47.6%)</td>
<td>10 (47.6%)</td>
<td>.690</td>
</tr>
</tbody>
</table>

Note. RN = Discharge team bedside nurse; ADN = Associate’s Degree in Nursing; BSN = Bachelor of Science in Nursing; DC = Discharge team discharge coordinator; MSW = Master of Social Work. aChi-squared goodness-of-fit test comparing team characteristics by inpatient unit type. bFisher’s exact chi-squared test comparing team characteristics by inpatient unit type. Not all percentages add up to a hundred due to rounding. *p < .05.
Table 14
An Overall, and by Unit Type, Summary of Mean, Standard Deviations, and Minimum/Maximum values for Team Characteristics

<table>
<thead>
<tr>
<th>Team Characteristic</th>
<th>Overall (N = 64)</th>
<th>Medical (n = 22)</th>
<th>Orthopedic (n = 21)</th>
<th>Cardiology (n = 21)</th>
<th>F&lt;sup&gt;a&lt;/sup&gt;</th>
<th>χ&lt;sup&gt;b&lt;/sup&gt;</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN Professional Experience (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;.001*</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>8.6 (6.9)</td>
<td>5.1 (5.1)</td>
<td>15.4 (5.5)</td>
<td>5.3 (4.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>(.25 - 25)</td>
<td>(1-25)</td>
<td>(6.5-22)</td>
<td>.25-13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Professional Experience (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.7</td>
<td>&lt;.001*</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>8.5 (8.0)</td>
<td>1.7 (.5)</td>
<td>11.1 (7.8)</td>
<td>13.2 (7.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>(.5-18)</td>
<td>(.5-2)</td>
<td>.5-17</td>
<td>.5-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD Professional Experience (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.156</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>16.8 (9.9)</td>
<td>15.1 (12.5)</td>
<td>20.2 (6.9)</td>
<td>15.2 (8.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>(1-41)</td>
<td>(1-41)</td>
<td>(6.5-29)</td>
<td>(1-30)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Professional Experience (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;.001*</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>11.9 (5.7)</td>
<td>7.5 (4.8)</td>
<td>16.4 (4.1)</td>
<td>11.8 (4.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>1.8-22.7</td>
<td>1.8-16.3</td>
<td>6.5-22</td>
<td>2.7-17.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Level of Hospital Experience (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;.001*</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td>10.7 (5.5)</td>
<td>6.9 (4.2)</td>
<td>14.9 (4.8)</td>
<td>10.3 (4.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/Max</td>
<td>1-23.7</td>
<td>1-17.9</td>
<td>6.5-23.7</td>
<td>2.7-17.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 14  (Continued)

<table>
<thead>
<tr>
<th>Team Characteristic</th>
<th>Overall</th>
<th>Medical</th>
<th>Orthopedic</th>
<th>Cardiology</th>
<th>$F^a$</th>
<th>$\chi^2 b$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (N = 64)</td>
<td>(n = 22)</td>
<td>(n = 21)</td>
<td>(n = 21)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Quality (Scale 1-7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>6.1 (0.6)</td>
<td>5.9 (0.7)</td>
<td>6.6 (0.4)</td>
<td>6 (.6)</td>
<td>14.3$^b$</td>
<td>&lt;.001$^*$</td>
<td></td>
</tr>
<tr>
<td>$Min/Max$</td>
<td>4.4-7</td>
<td>4.5-7</td>
<td>5.7-7</td>
<td>4.3-7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork Quality (Scale 1-7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.2$^b$</td>
<td>&lt;.001$^*$</td>
<td></td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>6.2 (0.7)</td>
<td>6.1 (0.6)</td>
<td>6.6 (0.4)</td>
<td>5.9 (4.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Min/Max$</td>
<td>4.4-7</td>
<td>4.5-7</td>
<td>5.7-7</td>
<td>4.4 – 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Float Staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>0.6 (0.6)</td>
<td>0.9(0.7)</td>
<td>.4 (.6)</td>
<td>0.6 (0.5)</td>
<td>2.8$^a$</td>
<td>.067</td>
<td></td>
</tr>
<tr>
<td>$Min/Max$</td>
<td>0-2</td>
<td>0-2</td>
<td>0-2</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Safety Perception (Scale 1-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.64$^a$</td>
<td>.530</td>
<td></td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>4.3 (0.3)</td>
<td>4.4(0.3)</td>
<td>4.3 (0.4)</td>
<td>4.3 (0.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Min/Max$</td>
<td>3.7-5</td>
<td>3.7-4.6</td>
<td>3.7-5</td>
<td>4-4.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. RN = Discharge team bedside nurse; DC = Discharge team discharge coordinator; MD = Discharge team physician. Team professional and hospital experience is the discharge teams’ RN, DC, and MD average years of professional or hospital experience, respectively. Adapted measures from Millward and Jeffries (2001) Team Survey were used to determine Communication Quality and Teamwork Quality (ranging from 0 [poor] to 7 [excellent]). Perception of safety was measured using the Global Safety Grade score (Sorra & Dryer, 2010) and aggregated to the team level by averaging discharge teams’ RN, DC, and MD scores. $^a$ANOVAs and $^b$Kruskal-Wallis comparing the discharge team continuous characteristics by unit type. $^*p < .05$.
Sample Description: Outcome Variables

Quality of Care Transition. Tables 15 and 16 provide a summary of the quality of transition CTM-15 outcome by patient and team-level characteristics. For this study, the average score for the patient participants \( n = 42 \) was a 79.2 out of the 100-point scale \( (SD = 17.3) \), with a minimum score of 45.45 and a maximum score of 100. The relationships between discharge event characteristics and the CTM-15 outcome were examined and are described below.

ANOVA and \( t \) tests were used to examine the differences in the effects of the categorical variables (representing patient and team characteristics) on the patient’s CTM-15 scores. Significant \( F \) tests were followed by pairwise comparisons using Tukey's Studentized Range (HSD) test. The assumptions of normality, independence, and equal variances were met. The ANOVA results are shown in Table 15. A considerable portion of the patient and team characteristics were not statistically significantly related to the CTM-15. However, the CTM-15 mean scores differed by inpatient unit type, \( F_{2,39} = 12.6, p < .0001 \). Post hoc analyses using Tukey’s HSD test criterion indicated that the mean CTM-15 scores for the Medical unit \( (M = 68.7, SD = 12.6) \) and the Cardiology unit \( (M = 70.3, SD = 17.62) \) were each significantly lower than the Orthopedic unit score \( (M = 90.9, SD = 12.2) \). Additionally, a significant effect of patient principal diagnosis on CTM-15 scores was also found, \( F_{2,39} = 5.2, p = .001 \). Post hoc comparisons using the Tukey HSD test indicated that the mean CTM-15 score for patients admitted for knee replacements \( (M = 94.5, SD = 7.9) \) was significantly higher than the patients admitted for an AMI \( (M = 71, SD = 19.7) \), CHF \( (M = 69.4, SD = 17) \), or COPD \( (M = 66.8, SD = 14.7) \).

Pearson correlation coefficients were used to explore the relationship between the CTM-15 scores and the continuous variables representing patient and team characteristics (see Table 16). In this sample, the patients' CTM-15 scores were significantly correlated with the patient characteristics such as age \( (r = -.43, p = .005) \), number of hospitalizations \( (r = -.43, p = .004) \), number of ED visits \( (r = -.47, p = .002) \), number of comorbidities \( (r = -.46, p = .002) \), level of cognition \( (r = -.52, p < .000) \), and expected support \( (r = .34, p = .029) \). The patient CTM-15 scores were also significantly correlated with the team-level characteristics such as discharge team RN years of professional experience \( (r = .33, p = .034) \), day of
discharge communication quality \((r = .39, p = .010)\), and day of discharge teamwork quality \((r = .33, p = .033)\). The CTM-15 scores were significantly related to the team processes of interest including the discharge teams’ average Teamwork SMM score (measured using the teams’ average Shared Mental Model scale scores; \(r = .55, p < .001\)) and Teamwork SMM Convergence \((r = .51, p < .001)\), as well as the discharge team average Teamwork SMM scores (measured using the teams’ average DP-RHDS/SF scores; \(r = .56, p < .001\)) and Taskwork SMM Convergence \((r = .41, p = .007)\).
### Table 15

**Summary of Mean (M) and Standard Deviation (SD) of the Quality of Transition Outcome**

<table>
<thead>
<tr>
<th>Discharge Event Characteristic</th>
<th>n</th>
<th>M ± SD</th>
<th>t or F&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>42</td>
<td>79.2 ± 17.3</td>
<td>12.6</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td><strong>Unit Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>12</td>
<td>68.7 ± 12.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedic</td>
<td>19</td>
<td>90.9 ± 12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiology</td>
<td>11</td>
<td>70.2 ± 17.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Principal Diagnosis</strong></td>
<td></td>
<td></td>
<td>5.2</td>
<td>.001*</td>
</tr>
<tr>
<td>CHF</td>
<td>5</td>
<td>69.4 ± 17.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMI</td>
<td>6</td>
<td>71.0 ± 19.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Replacement</td>
<td>9</td>
<td>87.0 ± 15.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee Replacement</td>
<td>10</td>
<td>94.5 ± 7.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>5</td>
<td>71.4 ± 9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>7</td>
<td>66.8 ± 14.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Gender</strong></td>
<td></td>
<td></td>
<td>&lt;.1</td>
<td>.996</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>79.2 ± 18.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>79.2 ± 15.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td>1.6</td>
<td>.130</td>
</tr>
<tr>
<td>Non-white</td>
<td>4</td>
<td>91.7 ± 13.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>38</td>
<td>77.9 ± 17.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Insurance Payer</strong></td>
<td></td>
<td></td>
<td>0.9</td>
<td>.471</td>
</tr>
<tr>
<td>Medicaid and Medicare</td>
<td>4</td>
<td>88.7 ± 16.4</td>
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<td></td>
</tr>
<tr>
<td>Private Plan</td>
<td>3</td>
<td>88.89 ± 17.3</td>
<td></td>
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<tr>
<td>Private and Medicare</td>
<td>23</td>
<td>77.1 ± 16.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare Only</td>
<td>12</td>
<td>77.6 ± 19.6</td>
<td></td>
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<tr>
<td><strong>Patient Marital Status</strong></td>
<td></td>
<td></td>
<td>2</td>
<td>.059</td>
</tr>
<tr>
<td>Married</td>
<td>29</td>
<td>82.5 ± 15.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>13</td>
<td>71.7 ± 19.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Housing Type</strong></td>
<td></td>
<td></td>
<td>0.6</td>
<td>.524</td>
</tr>
<tr>
<td>House/Apartment/Condo</td>
<td>40</td>
<td>79.6 ± 16.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assisted Living</td>
<td>2</td>
<td>71.4 ± 33.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Household Occupancy</strong></td>
<td></td>
<td></td>
<td>1.1</td>
<td>.332</td>
</tr>
<tr>
<td>Lives Alone</td>
<td>11</td>
<td>72.6 ± 21.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives with 1 Person</td>
<td>24</td>
<td>81.0 ± 15.2</td>
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<tr>
<td>Lives with 2+ People</td>
<td>7</td>
<td>79.8 ± 17.6</td>
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Table 15 (Continued)

<table>
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<tr>
<th>Discharge Event Characteristic</th>
<th>n</th>
<th>M ± SD</th>
<th>t or F</th>
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<td>Non-High School Graduate</td>
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<td>High School Graduate</td>
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<td>75.7 ± 17.3</td>
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<tr>
<td>Some College or Higher</td>
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<td>Patient Planned Admission</td>
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<tr>
<td>No</td>
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<td>69.4 ± 14.8</td>
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<tr>
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<td>19</td>
<td>90.9 ± 12.2</td>
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<td>Patient ICU Admission</td>
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<td>ADN</td>
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<td>82.2 ± 15.0</td>
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<tr>
<td>BSN</td>
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<td>75.5 ± 19.5</td>
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<td>DC Education</td>
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<td>.513</td>
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<td>ADN</td>
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<td>81.3 ± 18.0</td>
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<td>BSN</td>
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<td>74.7 ± 13.7</td>
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<td></td>
</tr>
<tr>
<td>MSW</td>
<td>9</td>
<td>81.7 ± 21.1</td>
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<td></td>
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<tr>
<td>Yes</td>
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<td>77.05 ± 18.42</td>
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<td>Patient-Team Communication</td>
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<td>No</td>
<td>8</td>
<td>84.8 ± 18.5</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
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<td>77.8 ± 17.0</td>
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<tr>
<td>New Day of Discharge Team</td>
<td>1.8</td>
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<td>No</td>
<td>21</td>
<td>83.8 ± 18.0</td>
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<tr>
<td>Yes</td>
<td>21</td>
<td>74.5 ± 15.7</td>
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</tbody>
</table>

Note. n = 42; COPD = Chronic Obstructive Pulmonary Disease; CHF = Congestive Heart Failure; AMI = Acute Myocardial Infarction; ICU = Intensive Care Unit; RN = Discharge team bedside nurse; DC = Discharge team discharge coordinator; MD = Discharge team physician. Quality of Transition was measured using the CTM-15 scale (ranging from 0 [poor] to 100 [excellent]). *ANOVA and t tests compared CTM-15 scores across patient and team characteristics. *p < .05.
Table 16
Bivariate Relationships using Pearson’s Correlationsa between Quality of Transition and Patient Characteristics, Team Characteristics, and Team Processes

<table>
<thead>
<tr>
<th>Discharge Event Characteristic</th>
<th>Quality of Transition (n = 42)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
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<tr>
<td>Patient Characteristics</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
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</tr>
<tr>
<td>Number of Admission</td>
<td>-.43</td>
</tr>
<tr>
<td>Number of ED Visits</td>
<td>-.47</td>
</tr>
<tr>
<td>Length of Stay (Days)</td>
<td>-.09</td>
</tr>
<tr>
<td>Number of Medications</td>
<td>-.15</td>
</tr>
<tr>
<td>Number of Comorbidities</td>
<td>-.46</td>
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<tr>
<td>Level of Cognition (Scale 0-7)</td>
<td>-.52</td>
</tr>
<tr>
<td>Coping Ability (Scale 0-10)</td>
<td>.19</td>
</tr>
<tr>
<td>Expected Support (Scale 0-10)</td>
<td>.34</td>
</tr>
<tr>
<td>Discharge Team Characteristics</td>
<td></td>
</tr>
<tr>
<td>RN Professional Experience (Years)</td>
<td>.33</td>
</tr>
<tr>
<td>DC Professional Experience (Years)</td>
<td>.10</td>
</tr>
<tr>
<td>MD Professional Experience (Years)</td>
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<tr>
<td>Team Professional Experience (Years)</td>
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<tr>
<td>Communication Quality (Scale 1-7)</td>
<td>.39</td>
</tr>
<tr>
<td>Teamwork Quality (Scale 1-7)</td>
<td>.33</td>
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<tr>
<td>Team Safety Perception (Scale 1-5)</td>
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<tr>
<td>Team Processes of Interest</td>
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<tr>
<td>Teamwork SMM (Scale 1-7)</td>
<td>.55</td>
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<tr>
<td>Teamwork SMM Convergence (0-1)</td>
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<tr>
<td>Taskwork SMM (0-10)</td>
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<tr>
<td>Taskwork SMM Convergence (0-1)</td>
<td>.41</td>
</tr>
<tr>
<td>Taskwork SMM Accuracy</td>
<td>-.12</td>
</tr>
</tbody>
</table>

Note. ED = Emergency Department; RN = Discharge team nurse; DC = Discharge team discharge coordinator; MD = Discharge team physician. Quality of Transition was measured using the CTM-15 scale (ranging from 0 [poor] to 100 [excellent]). Level of Cognition was measured using the Short Portable Mental Status exam: ranges from 0 (intact) to 10 (severe impairment). Patient Readiness for Hospital Discharge Scale subscales were used to measure coping ability which ranges from 1 (poor) to 10 (excellent), and expected support which ranges from 0 (none) to 10 (great deal). Team level of professional and hospital experience is the discharge teams’ RN, DC, and MD average years of professional or hospital experience, respectively. Adapted measures from Millward and Jeffries (2001) Team Survey measured Communication Quality and Teamwork Quality (ranging from 0 [poor] to 7 [excellent]). Perception of safety was measured using the Global Safety Grade score (Sorra & Dryer, 2010) and aggregated to the team level by averaging discharge teams’ RN, DC, and MD scores ranging from 1 (failing) to 5 (excellent). p < .05.
**Missing CTM-15 responses.** Of the 64 enrolled patients, 66% \((n = 42)\) completed the questions for the Quality of Transition (CTM-15 scale). The samples between those who completed \((n = 42)\) and those who did not complete the CTM-15 \((n = 22)\) were compared. Fisher's probability exact tests were used to examine the differences in the patient samples with and without the CTM-15 by the patient and team categorical characteristics. Whereas \(t\) tests were used to examine the differences in the patient samples with and without the CTM-15 by the patient and team continuous characteristics. The equality of variances were examined, and if needed Levene's \(t\) test was used. Notably the two groups did not differ by the majority of patient and team participant characteristics: number of medications, number of comorbidities, level of cognition, level of expected support, level of coping, gender, race/ethnicity, insurance payer, educational attainment, employment, ICU admissions, number of admits, full team communication, household occupancy, number of floats, new day of discharge team, DC years of experience, teamwork convergence, task convergence, and team perception of safety.

Using Fisher's probability exact test a significant difference was found between those who completed the CTM-15 and those who did not on the following variables, being married, \(\chi^2(1, N = 64), p < .04\) (76.3% of completed CTM-15 sample was married vs. 23.7% of missing CTM-15 sample) and having a planned admission, \(\chi^2(1, N = 64), p < .005\) (53.5% of completed CTM-15 sample had a planned admission vs. 46.5% of missing CTM-15 sample). Difference in the means of the two groups was found for Team professional experience \(t = 3.45, p = .001\); team communication quality \(t = 2.25, p = .029\); RN years of experience \(t = 4.07, p < .001\); MD years of experience \(t = 2.18, p = .034\); and, teamwork quality \(t = 2.1 p = .020\).

**Unplanned Utilization of Medical Services.** As depicted in Figure 8, of the 64 completed day of discharge events, follow-up data regarding utilization of unplanned medical services were collected for 56 discharge events. Thirty days after hospital discharge, the patients self-reported in the follow-up interview/questionnaire if they had an unplanned readmission and/or unplanned ED visit (yes/no) (Aim 2A, 2B). Of the six patients that were unable to be contacted, two were Medical patients and four were Cardiology patients. The patient characteristics of those who were missing and those who completed the utilization of
unplanned services were compared, and no significance differences between the samples were found. Out of the 56 patients who responded to the follow-up, there were 18 (32.1%) who reported utilizing unplanned medical services. Information from discharge events for which the patients had passed away \((n = 4)\) was reported by family members.

Fisher’s probability exact tests were used to examine the relationships between unplanned utilization of medical services to the patient- and team-level categorical variables. Table 17 provides the frequencies of patients utilizing and not utilizing unplanned medical services by patient- and team-level characteristics. There was a significant difference between the inpatient unit types for the number of discharge event patients that utilized an unplanned medical service \(\chi^2(2, n = 56), p < .001\). The Medical unit had the highest frequency of discharge events with unplanned medical services, with 55% of the patient sample reporting unplanned utilization of a medical service \((n = 11)\). The Cardiology unit had the second highest rate of unplanned utilization of medical services, with 29.4% of those who responded \((n = 5)\) reported they had done so. Last, the Orthopedic unit had only 9.5% of respondents \((n = 2)\) who reported unplanned utilization of medical services. Additionally, the discharge events differed significantly by insurance type \(\chi^2(2, n = 56), p = .047\); household occupancy \(\chi^2(2, n = 56), p = .011\); and by having a planned hospital admission \(\chi^2(2, n = 56), p = .009\).

\(T\) tests were used to examine the differences in unplanned utilization by the patient and team continuous characteristics. The equality of variances were examined, and if needed Levene’s \(t\) test was used. Table 18 shows the \(t\)-test results, and notably the two groups did not differ by the majority of patient and team participant characteristics. However, the mean number of ED visits was higher for those with unplanned utilization of medical services than those who did not \((M = 1.89 \text{ vs. } M = 1.03; p = .023)\). Patients who utilized unplanned medical services had discharge teams with a nurse who had less professional experience \((M = 5.78; SD = 5.89)\) compared to those who did not utilize unplanned medical services \((M = 10.43; SD = 6.91; p = .016)\). Whereas the mean score of communication quality and teamwork quality was lower for those who utilized unplanned medical services than those who did not \((M = 5.77 \text{ vs. } M = 6.38, p = .005; M = 5.80 \text{ vs. } M = 6.4, p = .004, \text{ respectively})\).
Table 17
Summary of Discharge Event Characteristics by Utilization of Unplanned Medical Services Categories

<table>
<thead>
<tr>
<th>Discharge Event Characteristic</th>
<th>No (n = 40)</th>
<th>Yes (n = 18)</th>
<th>p^a</th>
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<tr>
<td>Utilization of Unplanned Medical Services</td>
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</tr>
<tr>
<td>(n = 58)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Overall</td>
<td>40 (69%)</td>
<td>18 (31.1%)</td>
<td></td>
</tr>
<tr>
<td>Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>9 (45%)</td>
<td>11 (55%)</td>
<td>&lt; .001^b</td>
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<tr>
<td>Orthopedic</td>
<td>19 (90.5%)</td>
<td>2 (9.5%)</td>
<td></td>
</tr>
<tr>
<td>Cardiology</td>
<td>12 (70.6%)</td>
<td>5 (29.4%)</td>
<td></td>
</tr>
<tr>
<td>Principal Diagnosis</td>
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<td></td>
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<tr>
<td>CHF</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
<td>.069^b</td>
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<tr>
<td>AMI</td>
<td>6 (66.7%)</td>
<td>3 (33.3%)</td>
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</tr>
<tr>
<td>Hip Replacement</td>
<td>10 (90.9%)</td>
<td>1 (9.1%)</td>
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</tr>
<tr>
<td>Knee Replacement</td>
<td>9 (90%)</td>
<td>1 (10%)</td>
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</tr>
<tr>
<td>Pneumonia</td>
<td>4 (40%)</td>
<td>6 (60%)</td>
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</tr>
<tr>
<td>COPD</td>
<td>5 (50%)</td>
<td>5 (50%)</td>
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<tr>
<td>Patient Gender</td>
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<tr>
<td>Female</td>
<td>22 (73.3%)</td>
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<tr>
<td>Male</td>
<td>18 (64.3%)</td>
<td>10 (35.7%)</td>
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<td>Patient Race/Ethnicity</td>
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<td>Non-white</td>
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<tr>
<td>White</td>
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<tr>
<td>Patient Insurance Payer</td>
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<td>.047^*</td>
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<td>Medicaid and Medicare</td>
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<td>1 (12.5%)</td>
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<td>Private Plan</td>
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<td>Private and Medicare</td>
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<td>15 (46.9%)</td>
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<td>2 (13.3%)</td>
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<td>Lives alone</td>
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<td>Lives with 1 person</td>
<td>26 (83.9%)</td>
<td>5 (16.1%)</td>
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<tr>
<td>Lives with 2+ people</td>
<td>2 (28.6%)</td>
<td>5 (71.4%)</td>
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</table>
Table 17 (Continued)

<table>
<thead>
<tr>
<th>Discharge Event Characteristic</th>
<th>No (n=40)</th>
<th>Yes (n=18)</th>
<th>p</th>
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<tbody>
<tr>
<td>Patient Educational Attainment</td>
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<td>.624</td>
</tr>
<tr>
<td>Non-high School Graduate</td>
<td>3 (60%)</td>
<td>2 (40%)</td>
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</tr>
<tr>
<td>High School Graduate</td>
<td>23 (74.2%)</td>
<td>8 (25.8%)</td>
<td></td>
</tr>
<tr>
<td>Some College or Higher</td>
<td>14 (63.6%)</td>
<td>8 (36.3%)</td>
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</tr>
<tr>
<td>Patient Employment Status</td>
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<tr>
<td>Working</td>
<td>10 (83.3%)</td>
<td>2 (16.7%)</td>
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<tr>
<td>Retired</td>
<td>29 (67.4%)</td>
<td>14 (32.6%)</td>
<td></td>
</tr>
<tr>
<td>Unemployed or Disabled</td>
<td>1 (33.3%)</td>
<td>2 (66.7%)</td>
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<td>Planned Admission</td>
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<td>21 (56.8%)</td>
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<td>19 (90.5%)</td>
<td>2 (9.5%)</td>
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<tr>
<td>ICU Admission</td>
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<td>No</td>
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<tr>
<td>Yes</td>
<td>3 (60%)</td>
<td>2 (40%)</td>
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<tr>
<td>RN Education</td>
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<td></td>
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<tr>
<td>ADN</td>
<td>23 (63.9%)</td>
<td>13 (36.1%)</td>
<td></td>
</tr>
<tr>
<td>BSN</td>
<td>17 (77.3%)</td>
<td>5 (22.7%)</td>
<td></td>
</tr>
<tr>
<td>DC Education</td>
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<td>.227</td>
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<tr>
<td>ADN</td>
<td>19 (79.2%)</td>
<td>5 (20.8%)</td>
<td></td>
</tr>
<tr>
<td>BSN</td>
<td>11 (55%)</td>
<td>9 (45%)</td>
<td></td>
</tr>
<tr>
<td>MSW</td>
<td>10 (71.4%)</td>
<td>4 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Team Communication</td>
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<td>.384</td>
</tr>
<tr>
<td>No</td>
<td>17 (77.3%)</td>
<td>5 (22.7%)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23 (63.9%)</td>
<td>13 (36.1%)</td>
<td></td>
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<tr>
<td>Patient-Team Communication</td>
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<td>No</td>
<td>8 (80%)</td>
<td>2 (20%)</td>
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</tr>
<tr>
<td>Yes</td>
<td>32 (66.7%)</td>
<td>16 (33.3%)</td>
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<td>New Day of Discharge Team</td>
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<td>No</td>
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</tr>
<tr>
<td>Yes</td>
<td>17 (65.4%)</td>
<td>9 (34.6%)</td>
<td></td>
</tr>
</tbody>
</table>

Note. COPD = Chronic Obstructive Pulmonary Disease; CHF = Congestive Heart Failure; AMI = Acute Myocardial Infarction; PNA = Pneumonia; ICU = Intensive Care Unit; RN = Discharge team bedside nurse; DC = Discharge team discharge coordinator; MD = Discharge team physician. Not all percentages add up to a hundred due to rounding. aChi-squared goodness-of-fit text comparing team characteristics by inpatient unit type. bFisher’s exact chi-squared test comparing team characteristics by inpatient unit type. *p <.05.
Table 18
Summary of Discharge Event Characteristics by Utilization of Unplanned Medical Services

<table>
<thead>
<tr>
<th>Discharge Event Characteristic</th>
<th>No (n = 40)</th>
<th>Yes (n = 18)</th>
<th>t Test ( t(56) )</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M ± SD</td>
<td>M ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patient Characteristic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>74.8 ± 7.1</td>
<td>75.5 ± 8.9</td>
<td>0.3</td>
<td>.749</td>
</tr>
<tr>
<td>Number of Admissions</td>
<td>1.5 ± 1.0</td>
<td>1.9 ± 1.2</td>
<td>1.4</td>
<td>.155</td>
</tr>
<tr>
<td>Number of ED Visits</td>
<td>1.0 ± 1.2</td>
<td>1.9 ± 1.5</td>
<td>2.3</td>
<td>.023*</td>
</tr>
<tr>
<td>Length of Stay (Days)</td>
<td>3.6 ± 1.2</td>
<td>4.6 ± 2.5</td>
<td>2.0</td>
<td>.141</td>
</tr>
<tr>
<td>Number of Medications</td>
<td>10.9 ± 5.9</td>
<td>12.3 ± 5.8</td>
<td>0.8</td>
<td>.404</td>
</tr>
<tr>
<td>Number of Comorbidities</td>
<td>4.7 ± 2.5</td>
<td>6.2 ± 3.4</td>
<td>1.9</td>
<td>.067</td>
</tr>
<tr>
<td>Level of Cognition (Scale 0-7)</td>
<td>0.6 ± 0.9</td>
<td>0.6 ± 1.1</td>
<td>0.6</td>
<td>.573</td>
</tr>
<tr>
<td>Coping Ability (Scale 0-10)</td>
<td>8.7 ± 1.4</td>
<td>8.1 ± 1.5</td>
<td>1.5</td>
<td>.140</td>
</tr>
<tr>
<td>Expected Support (Scale 0-10)</td>
<td>6.9 ± 3.7</td>
<td>6.0 ± 3.9</td>
<td>0.9</td>
<td>.372</td>
</tr>
<tr>
<td><strong>Discharge Team Characteristic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN Professional Experience (Years)</td>
<td>10.4 ± 6.9</td>
<td>5.8 ± 5.9</td>
<td>2.5</td>
<td>.016*</td>
</tr>
<tr>
<td>DC Professional Experience (Years)</td>
<td>9.9 ± 8.1</td>
<td>6.0 ± 7.4</td>
<td>1.7</td>
<td>.092</td>
</tr>
<tr>
<td>MD Professional Experience (Years)</td>
<td>16.1 ± 8.9</td>
<td>19.4 ± 12.7</td>
<td>1.2</td>
<td>.255</td>
</tr>
<tr>
<td>Team Professional Experience (Years)</td>
<td>12.1 ± 5.1</td>
<td>10.4 ± 6.1</td>
<td>1.1</td>
<td>.268</td>
</tr>
<tr>
<td>Communication Quality (Scale 1-7)</td>
<td>6.4 ± 0.5</td>
<td>5.8 ± 0.8</td>
<td>3.1</td>
<td>.005*</td>
</tr>
<tr>
<td>Teamwork Quality (Scale 1-7)</td>
<td>6.5 ± 0.5</td>
<td>5.8 ± 0.8</td>
<td>3.2</td>
<td>.004*</td>
</tr>
<tr>
<td>Number of Float Staff</td>
<td>0.6 ± 0.7</td>
<td>0.8 ± 0.6</td>
<td>1.1</td>
<td>.269</td>
</tr>
<tr>
<td>Team Safety Perception (Scale 1-5)</td>
<td>4.3 ± 0.3</td>
<td>4.4 ± 0.3</td>
<td>1.3</td>
<td>.207</td>
</tr>
<tr>
<td><strong>Team Processes of Interest</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork SMM (Scale 1-7)</td>
<td>6.2 ± .8</td>
<td>5.9 ± 0.9</td>
<td>2.26</td>
<td>.010*</td>
</tr>
<tr>
<td>Teamwork SMM Convergence (0-1)</td>
<td>.8 ± .1</td>
<td>.8 ± .1</td>
<td>2.7</td>
<td>.009*</td>
</tr>
<tr>
<td>Taskwork SMM (Scale 0-10)</td>
<td>8.6 ± .8</td>
<td>8.2 ± 1.0</td>
<td>1.6</td>
<td>.122</td>
</tr>
<tr>
<td>Taskwork SMM Convergence (0-1)</td>
<td>.9 ± .1</td>
<td>.9 ± .1</td>
<td>1</td>
<td>.337</td>
</tr>
<tr>
<td>Taskwork SMM Accuracy</td>
<td>1.1 ± 0.8</td>
<td>1.3 ± 0.8</td>
<td>1.1</td>
<td>.273</td>
</tr>
</tbody>
</table>

*Note. RN = Discharge team bedside nurse; DC = Discharge team discharge coordinator; MD = Discharge team physician. Adapted measures from Millward and Jeffries (2001) Team Survey were used to determine Communication Quality and Teamwork Quality (ranging from 0 [poor] to 7 [excellent]). Perception of safety was measured using the Global Safety Grade score (Sorra & Dryer, 2010) and aggregated to the team level by averaging discharge teams’ RN, DC, and MD scores. *Using t tests, discharge event characteristics were compared for those who did (yes) and those who did not (no) utilized unplanned medical services. *p < .05.
Specific Aim 1 Results

The focus of Aim 1 was to describe the degree of convergence for discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units. The research questions included:

- **Question 1A.** What are the teams’ average Teamwork SMM and Teamwork SMM Convergence scores among the members’ individual mental models at the time of patient discharge?
- **Question 1B.** What are the teams’ average Taskwork SMM and Taskwork SMM convergence scores among the members’ individual mental models at the time of patient discharge?
- **Question 1C.** Is there a difference among the inpatient units mean scores for a) Teamwork SMMs, b) Teamwork SMM Convergence, c) Taskwork SMMs, and/or Taskwork SMM Convergence?

The analysis for Aim 1 was limited to the inpatient discharge teams. The variables for Aim 1 – average Teamwork SMM scores, degrees of Teamwork SMM convergence, average Taskwork SMM scores, and degrees of Taskwork SMM convergence – were created. The final analytic sample included 64 unique discharge teams across three inpatient units.

**Teamwork SMM (Aim 1A)**

For each discharge event, the providers’ individual scores on the Shared Mental Models Scale were averaged to determine a team average Teamwork SMM content score (or Teamwork SMM score). Discharge teams with higher quality Teamwork SMMs scores reported having a greater shared understanding of members’ roles/responsibilities, knowledge of team members’ skills and abilities, and awareness of who, what, and when to communicate key information to each other as compared with teams with lower scores. Overall, the discharge teams reported relatively high quality Teamwork SMMs among the RN, MD, and DC on the day of hospital discharge. The mean Teamwork SMM score for all discharge teams was 6.11 (Median [Mdn] = 6.13; SD = 0.39), and ranged in scores from 5.15 to 6.97. As shown in Table 19a, the mean Teamwork SMM scores were calculated for each inpatient unit: Medical unit ([M] = 5.99, Mdn = 6.08, SD = 0.36), Orthopedic unit ([M] = 6.34, Mdn = 6.36, SD = 0.33), and Cardiology unit ([M] = 6.01, Mdn = 6.03, SD = .37).
Teamwork SMM Convergence (Aim 1A)

To determine the degree of convergence of Teamwork SMM for each team, an interrater agreement index ($r_{wg(j)}^*$) was calculated for each discharge event from the provider scores on the Shared Mental Models Scale. The values for $r_{wg(j)}^*$ range from 0 to 1: where the value of 1.0 is complete agreement, .5 indicates agreement equal to uniform null distributions, and 0 indicates theoretical maximum disagreement. Overall the discharge teams showed relatively high levels of Teamwork SMM Convergence, indicating that the RN, MD, and DC had a high level of agreement on the quality of day of discharge Teamwork SMMs. The mean Teamwork SMM Convergence score for all discharge teams ($N = 64$) was .85 ($Mdn = .88; SD = .10$), and ranged in scores from .55 to 1.0. As shown in Table 19a, the mean Teamwork SMM Convergence score was calculated for each inpatient unit: Medical unit ($M = .81; Mdn = .81; SD = .11$), Orthopedic unit ($M = .90; Mdn = .90; SD = .06$), and Cardiology unit ($M = .85; Mdn = .88; SD = .10$).

Taskwork SMM (Aim 1B)

To determine the team's average Taskwork SMM (Aim 1B), the individual provider's scores on the DP-RHDS/SF were averaged together. Higher averages of Taskwork SMM score indicate that the team perceived the patient as being more prepared for hospital discharge. Overall the discharge teams reported relatively high levels of Taskwork SMMs among the RN, MD, and DC on the day of hospital discharge, indicating that the discharge team perceived that patients were ready for hospital discharge. The mean Taskwork SMM score for all discharge teams ($N = 64$) was 8.46 ($Mdn = 8.60; SD = .91$), and ranged in scores from 5.54 to 9.96. As shown in Table 19a, the mean Taskwork SMM scores were calculated for each inpatient unit: Medical unit ($M = 8.03, Mdn = 8.17, SD = 1.02$), Orthopedic unit ($M = 8.95, Mdn = 9.17, SD = .65$), and Cardiology unit ($M = 8.42, Mdn = 8.58, SD = .81$).

Taskwork SMM Convergence (Aim 1B)

To determine the degree of convergence of Taskwork SMM for each team (Aim 1B), $r_{wg(j)}^*$ was calculated from the provider scores on the DP-RHDS/SF. The values for $r_{wg(j)}^*$ range from 0 to 1: where the value of 1.0 is complete agreement, .5 indicates agreement equal to uniform null distributions, and 0 indicates theoretical maximum disagreement. Overall, the discharge teams' showed relatively high levels of Taskwork SMM Convergence,
indicating that the RN, MD, and DC had a high level of agreement on the patient’s readiness for hospital discharge. The mean Taskwork SMM Convergence score for all discharge teams \((N = 64)\) was \(.90 (Mdn = .93; SD = .10)\), and the scores ranged from \(.66 \) to \(1.0\). As shown in Table 19a, the mean Taskwork SMM Convergence score were calculated for each inpatient unit: Medical \((M = .85; Mdn = .86; SD = .09)\), Orthopedic \((M = .95; Mdn = .97; SD = .09)\), and Cardiology \((M = .89; Mdn = .93; SD = .10)\).

**Inpatient Unit Comparisons (Aim 1C)**

An ANOVA was used to compare the three-inpatient unit groups with regard to means of Teamwork SMMs. The null hypothesis stated there is not a group mean difference in Teamwork SMM scores. The assumptions of normality, independence, and equal variances were met. As shown in Table 19b, ANOVA results indicated that the effect of inpatient unit on Teamwork SMM score was significant \((F(2,61) = 6.63, p = .0025)\) at the \(p < .05\) level. Post hoc comparisons using the Tukey’s HSD test indicated that the mean Teamwork SMM score for the Medical unit \((M = 5.99; SD = .36)\) and the Cardiology unit \((M = 6.01; SD = 0.374)\) was significantly lower than the Orthopedic unit \((M = 6.34, SD = 0.33)\). The differences in Teamwork SMM scores between the Medical and Cardiology unit were not significant. The distribution between of the Teamwork SMM scores by inpatient unit type are shown in Appendix G Figure G1.

A second ANOVA was conducted to compare the mean Teamwork SMM Convergence score among the three inpatient unit groups. The assumptions of normality, independence, and equal variances were met. The results were significant for mean differences of Teamwork SMM Convergence score for the three inpatient units, \(F(2,61) = 4.91, p = .0106\) (see Table 19b). Post hoc comparisons using the Tukey’s HSD test indicated that the mean Teamwork SMM Convergence score for the Medical unit \((M = .81; SD = .11)\) was significantly lower than the Orthopedic unit \((M = .90; SD = .06)\). The differences in Teamwork SMM Convergence scores between the Medical and Cardiology units, as well as between the Orthopedic and Cardiology units, were not significant. The distribution between of the Teamwork SMM Convergence scores by inpatient unit type are shown in Appendix GFigure G2.
A third ANOVA was conducted to compare the effects of inpatient unit on Taskwork SMM. The null hypothesis was that there is not a group mean difference in Taskwork SMM scores. The assumptions of normality, independence, and equal variances were met. The ANOVA showed that the effect of inpatient unit on Taskwork SMM score was significant, \( F(2,61) = 6.51, p = .0027 \). Post hoc comparisons using the Tukey’s HSD test indicated that the mean Taskwork SMM score for the Medical unit \((M = 8.03; SD = 1.02)\) was significantly lower than the Orthopedic unit \((M = 8.95; SD = .65)\). The differences in Taskwork SMM scores between the Medical and Cardiology unit, as well as the Orthopedic unit and the Cardiology unit, were not significant. Appendix G Figure G3 shows the Taskwork SMM scores by inpatient unit type.

Finally, an ANOVA was conducted to compare the effects of inpatient unit on Taskwork SMM Convergence scores. The null hypothesis stated there is not a group mean difference in Taskwork SMM Convergence scores. The assumptions of normality, independence, and equal variances were met. As displayed in Table 19b, the results were significant for mean differences of Taskwork SMM Convergence score for the three inpatient units \( F(2,61) = 6.68, p = .0024 \). Post hoc comparisons using the Tukey’s HSD test indicated that the mean Taskwork SMM Convergence score for the Medical unit \((M = .85; SD = .09)\) was significantly lower than the Orthopedic unit \((M = .95; SD = .09)\). The differences in Taskwork SMM Convergence scores between the Medical and Cardiology units, as well as between the Orthopedic and Cardiology units, were not significant. Appendix G Figure G4 shows the Taskwork SMM Convergence scores by inpatient unit type.
Table 19a

Comparison of Discharge Teams’ Teamwork and Taskwork SMM Average and Convergence Scores across Inpatient Units

<table>
<thead>
<tr>
<th>Unit Type</th>
<th>Teamwork SMM</th>
<th>Teamwork Convergence</th>
<th>Taskwork SMM</th>
<th>Taskwork Convergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Units</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
</tr>
<tr>
<td>(N = 64)</td>
<td>6.11 (.39); 5.15 – 6.97</td>
<td>0.85 (.10); .55 - 1.0</td>
<td>8.46 (.91); 5.54 - 9.96</td>
<td>0.90 (.10); .66 - 1</td>
</tr>
<tr>
<td>Medical</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
</tr>
<tr>
<td>(n = 22)</td>
<td>5.99 (.36); 5.15 - 6.88</td>
<td>0.81 (.11); .55 - .99</td>
<td>8.03 (1.02); 5.54 -9.50</td>
<td>0.85 (.09); .71 -.98</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
</tr>
<tr>
<td>(n = 21)</td>
<td>6.34 (.33); 5.80 - 6.97</td>
<td>0.90 (.06); .77 - 1.0</td>
<td>8.95 (.65); 7.38 - 9.88</td>
<td>0.95 (.07); .66 -.99</td>
</tr>
<tr>
<td>Cardiology</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
<td>Mean (SD): Min/Max</td>
</tr>
<tr>
<td>(n = 21)</td>
<td>6.01 (.37); 5.15 - 6.85</td>
<td>.85 (.10); .63-.99</td>
<td>8.42 (.81); 6.88 - 9.96</td>
<td>.89 (.1); .66 - 1</td>
</tr>
</tbody>
</table>

Table 19b

ANOVA and Post Hoc Comparison of Discharge Teams’ Teamwork and Taskwork SMM Average and Convergence Scores across Inpatient Units using Tukey HSD Test

<table>
<thead>
<tr>
<th></th>
<th>Orthopedic vs. Medical</th>
<th>Cardiology vs. Medical</th>
<th>Orthopedic vs. Cardiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM</td>
<td>6.63 (.0025)**</td>
<td>0.36 (.10 -.62)**</td>
<td>0.33 (.07 -.60)**</td>
</tr>
<tr>
<td>Teamwork Convergence</td>
<td>4.91 (.0106)**</td>
<td>0.09 (.02 -.15)**</td>
<td>0.11 (-0.02 - 0.11)</td>
</tr>
<tr>
<td>Taskwork SMM</td>
<td>6.51 (.0027)**</td>
<td>0.93 (.31 - 1.54)**</td>
<td>0.54 (-0.09 - 1.16)</td>
</tr>
<tr>
<td>Taskwork Convergence</td>
<td>6.68 (.0024)**</td>
<td>0.10 (.03 -.16)**</td>
<td>0.05 (-0.01 - 0.12)</td>
</tr>
</tbody>
</table>

Note. Teamwork SMM = Discharge teams’ average score on the Shared Mental Model Scale; Teamwork Convergence = \( r_{wg(j)} \) among the discharge team members scores on the Shared Mental Model Scale; Taskwork SMM = Discharge teams’ average score on the Discharge Provider-Readiness for Hospital Discharge Scale Short Form (DP-RHDS/SF); Taskwork Convergence = \( r_{wg(j)} \) among the discharge team members score on the DP-RHDS/SF; SD = Standard Deviation; ANOVA = Analysis of variance; HSD = Honest significant difference. *One-way ANOVA. **Post hoc comparisons using Tukey allows further exploration of the differences between inpatient units. Significant p-value at the .05 level.
Specific Aim 2 Results

The focus of Aim 2 was to determine the relationship between discharge teams’ Teamwork and Taskwork SMMs on three inpatient hospital units and patient 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services) while controlling for contextual unit and patient characteristics. The research questions for Aim 2 included:

- **Question 2A.** After controlling for contextual unit and patient characteristics, is there a relationship between Teamwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); (i) if so, is that relationship modified by the degree of teamwork SMM convergence?

- **Question 2B.** After controlling for contextual unit and patient characteristics, is there a relationship between Taskwork SMM and 30-day post-hospitalization outcomes (quality of transition home and utilization of unplanned services); if so, is that relationship modified by (i) the degree of Taskwork SMM convergence and/or (ii) Taskwork accuracy?

Multivariable regression models were used to examine the relationship between SMMs (Teamwork and Taskwork) and patient post-hospitalization outcomes (Aim 2). The independent variable of interest for Aim 2A was the discharge teams’ Teamwork SMM, while the independent variable of interest for Aim 2B was the discharge teams’ Taskwork SMM. Two regression models were developed based off of the patient outcomes: the quality of transition and utilization of unplanned medical services.

Preliminary Variable Analysis for Model Selection

The next sections first discuss the preliminary analysis completed to evaluate the appropriateness of individual variables to be used for model selection. Because the process was the same for both models, the preliminary analysis for both is explained first, then each model will be discussed separately (see Figure 7).

**Variable evaluation for appropriateness.** Preliminary analyses were performed to examine the variables for appropriateness of inclusion for model selection (see Figure 7). The preliminary analysis for the continuous and categorical are each explained next.

**Continuous variables.** Continuous covariates with high collinearity can lead to estimation issues in the multiple regression framework, so prior to estimation, these pairwise correlations and VIFs were inspected. Table 20 provides a Pearson correlation matrix of the key variables used in Aim 2. Table 20 only presents the variables included in the Final
model(s), however all predictor pairs were examined for collinearity. Notably three Pearson’s correlation coefficient pairs had a large (greater than .75) correlation: number of ED visits and number of admissions ($r = .75; p < .001$); teamwork quality and communication quality ($r = .89; p < .001$); and team professional experience and team hospital experience ($r = .86; p < .001$).
Table 20
Pearson Correlation Coefficients between Key Predictor Variables and the Quality of Transition (CTM-15)

<table>
<thead>
<tr>
<th>Key Predictor Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Teamwork SMM</td>
<td>.49***</td>
<td>.03***</td>
<td>.65**</td>
<td>.33*</td>
<td>-.10</td>
<td>-.18</td>
<td>-.18</td>
<td>-.19</td>
<td>.22</td>
<td>.59***</td>
<td>.55***</td>
<td></td>
</tr>
<tr>
<td>2 Taskwork SMM</td>
<td>-.27**</td>
<td>.39***</td>
<td>.60***</td>
<td>-.11</td>
<td>-.20</td>
<td>-.20</td>
<td>-.17</td>
<td>.26*</td>
<td>.51***</td>
<td>.56***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Taskwork Accuracy</td>
<td>-.02**</td>
<td>-.36**</td>
<td>.10</td>
<td>.16</td>
<td>.33**</td>
<td>.18</td>
<td>-.30*</td>
<td>-.05</td>
<td>-.12</td>
<td></td>
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<tr>
<td>4 Teamwork SMM Convergence</td>
<td>.34**</td>
<td>-.18</td>
<td>-.13</td>
<td>-.33**</td>
<td>-.14</td>
<td>.30**</td>
<td>.27*</td>
<td>.51**</td>
<td></td>
<td></td>
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<tr>
<td>5 Taskwork SMM Convergence</td>
<td>.00</td>
<td>-.05</td>
<td>-.31**</td>
<td>-.24*</td>
<td>.23</td>
<td>.17</td>
<td>.41**</td>
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<tr>
<td>6 Patient Age</td>
<td>-.08</td>
<td>.13</td>
<td>-.10</td>
<td>-.10</td>
<td>-.06</td>
<td>-.43**</td>
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</tr>
<tr>
<td>7 Patient Length of Stay</td>
<td>-.10</td>
<td>-.05</td>
<td>-.28*</td>
<td>-.21</td>
<td>-.09</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>8 Number of Comorbidities</td>
<td>.26*</td>
<td>-.13</td>
<td>-.10</td>
<td>-.46**</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9 Number of Admissions</td>
<td>-.24</td>
<td>-.06</td>
<td>-.43**</td>
<td></td>
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<tr>
<td>10 Team Professional Experience</td>
<td>.19</td>
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<td>11 Communication Quality</td>
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<tr>
<td>12 CTM-15 Score&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
<td></td>
<td>.39**</td>
</tr>
</tbody>
</table>

Note. N = 64 for each correlation, expect for the CTM-15 Score<sup>a</sup> where n = 42; Quality of Transition was measured using the CTM-15 scale (ranging from 0 [poor] to 100 [excellent]). Quality of Transition Model includes: 1, 2, 6, 8, and 10; Utilization of Unplanned Medical Services Model includes: 1, 2, and 1; *p < .05, **p < .01, ***p < .001
In addition to examining the predictor pair correlations, variance inflation factors (VIFs) were used to estimate how much the variance of a regression coefficient was inflated due to multicollinearity in the model. VIFs greater than 10 are a sign of strong multicollinearity, however all VIFs greater than a 4 were re-examined for appropriateness of inclusion. Prior to removing any variables, the VIFs ranged from 1.5 to 15.3, with 5 variables having a VIF greater than 10: patient expected support (14.9), Taskwork Accuracy (10.3), teamwork quality (15.3), ED visits (10.9), team hospital experience (13.4). Once four of the variables (number of ED visits, team hospital experience, patient expected support, and teamwork quality) were removed, the VIFs ranged from 1.5 to 4.8.

**Centered and scaled variables.** Prior to analysis three variables were centered and two variables were scaled. Centering and scaling facilitates interpretation by putting coefficients on the same scale (in terms of their effect size) as well as rendering the intercept of the model into a useful baseline measure. Teamwork SMM was centered to the mean (6.11) and scaled to the standard deviation (0.38). Likewise, Taskwork SMM was centered to the mean (8.46) and scaled to the standard deviation (0.91). Patient age was centered to the mean (75.03 years old). From this point forward these variables are centered and/or scaled unless otherwise noted.

**Categorical variables.** Due to small numbers of observations across categories, eight categorical variables were collapsed: gender, race/ethnicity, marital status, housing type, household occupancy, educational attainment, employment status, and insurance payer. Additionally, six variables were excluded from Aim 2 because of the limited number of observations per category: race/ethnicity, housing type, planned admission, ICU admission, MD educational background, and DC educational background. The operationalized categories used in this study are provided in Chapter 3 Table 4 and Table 6. Nominal variables were recoded for regression analysis. Figure 9 provides an overview of the candidate patient- and team-level covariates that were considered in the variable selection pool following the completion of the preliminary variable analysis step.
Quality of Transition Model

A modified AICc stepwise procedure was used to develop a linear regression model for the quality of care transition outcome. The following sections provide an overview of the modeling selection process (key covariate predictor selection, and modified stepwise selection), model diagnostics (model assumptions and evaluation of fit tests), and model testing (regression analysis and interaction evaluation).

Quality of Transition Model Selection. After evaluating the variables for appropriateness to be included in the model, the model selection process involved key covariate predictor selection, and then modified stepwise model selection (see Figure 7).

Key covariate predictor selection. Before using the stepwise procedure, nine variables of interest were identified a priori from the literature as key patient and team characteristics particularly important to consider during the hospital to home transition. To reduce the number of variables to be forced-in during the model selection process, a standard multiple regression analysis was performed between the dependent variable (Quality of Transition) and the theoretical a priori identified independent variables (Teamwork SMMs, Taskwork SMMs, Taskwork Accuracy, age, principal diagnosis, gender, length of stay, number of comorbidities, and inpatient unit type). Only variables that were
significant with a $p < .20$ in this model were considered for forced-in during the stepwise selection process. Analysis was performed using SAS PROC REG. Assumptions were tested by examining normal probability plots of residuals and scatter plots of residuals versus predicted residuals. No violations of normality, linearity, or homoscedasity of residuals were found in this initial “pre-selection” step.

The results of this model are labeled as the Quality of Transition Pre-Selection Model. Regression analysis revealed that the model significantly predicted quality of transition, $F(12, 29) = 5.85, p < .001$. $R^2$ for the model was .71, and adjusted $R^2$ was .59. Table 21 displays the unstandardized regression coefficients ($b$), intercept, and standardized regression coefficients ($\beta$) for each variable. In terms of the individual relationships between the independent variables and quality of transition, Taskwork Accuracy ($t = 0.02, p = .982$), length of stay ($t = -0.21, p = .837$), and patient gender ($t = 0.60, p = .553$), were not significantly related to quality of transition and therefore were not considered as variable to be forced-into the AICc Selection model.
<table>
<thead>
<tr>
<th>Variable</th>
<th>b</th>
<th>SE</th>
<th>p</th>
<th>t(41)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMMc, s</td>
<td>4.09</td>
<td>2.06</td>
<td>.057*</td>
<td>1.99</td>
<td>[0.20, -0.12]</td>
</tr>
<tr>
<td>Taskwork SMMc, s</td>
<td>5.30</td>
<td>2.45</td>
<td>.039*</td>
<td>2.16</td>
<td>[0.20, 0.28]</td>
</tr>
<tr>
<td>Taskwork Accuracy</td>
<td>.07</td>
<td>2.96</td>
<td>.982</td>
<td>0.02</td>
<td>[-6.20, -5.98]</td>
</tr>
<tr>
<td>Agec</td>
<td>-.46</td>
<td>.32</td>
<td>.163*</td>
<td>-1.43</td>
<td>[-1.20, -1.11]</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>-.30</td>
<td>1.45</td>
<td>.837</td>
<td>-0.21</td>
<td>[-3.20, -3.27]</td>
</tr>
<tr>
<td>Number of Comorbidities</td>
<td>-1.61</td>
<td>.75</td>
<td>.040*</td>
<td>-2.15</td>
<td>[-3.20, -3.13]</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>2.37</td>
<td>3.94</td>
<td>.553</td>
<td>0.60</td>
<td>[-5.70, 10.43]</td>
</tr>
<tr>
<td>Medical Unit (Cardiology)</td>
<td>-9.90</td>
<td>7.26</td>
<td>.183*</td>
<td>-1.36</td>
<td>[-24.74, 4.95]</td>
</tr>
<tr>
<td>Pneumonia (COPD)</td>
<td>-4.13</td>
<td>7.89</td>
<td>.605</td>
<td>-0.52</td>
<td>[-20.28, 12.01]</td>
</tr>
<tr>
<td>Orthopedic Unit (Cardiology)</td>
<td>5.10</td>
<td>7.54</td>
<td>.504</td>
<td>0.68</td>
<td>[-10.32, 20.51]</td>
</tr>
<tr>
<td>Hip (Knee)</td>
<td>-10.27</td>
<td>5.26</td>
<td>.061*</td>
<td>-1.95</td>
<td>[-21.03, 0.49]</td>
</tr>
<tr>
<td>Cardiology Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMI (CHF)</td>
<td>-8.86</td>
<td>-1.16</td>
<td>.053*</td>
<td>0.25</td>
<td>[-24.43, 6.71]</td>
</tr>
</tbody>
</table>

Note. Note. N = 42. aQuality of Transition was measured using CTM-15 (ranging from 0 [poor] to 100 [excellent]). bCentered to the Mean. cScaled to Standard Deviation. The patient principal diagnosis was by inpatient unit: Cardiology unit (CHF = 0 vs. AMI = 1), Medical unit (COPD = 0 vs. Pneumonia = 1), and Orthopedic unit (Knee replacements = 0 vs. Hip replacement = 1). *p < .05
**Modified stepwise model selection.** A modified stepwise multiple regression was then conducted in SAS Studio via PROC GLMSELECT. Variables were added or taken away from the model on the basis of AICc in order to identify a subset model for the quality of transition sample data \((n = 42)\). Based on the preliminary steps, six variables were forced into the model at each step (Teamwork SMM, Taskwork SMM, inpatient unit type, principal diagnosis, patient age, and number of comorbidities). There were 20 candidate patient- and team-level covariates that were considered in the variable selection pool (patient gender, patient marital status, length of stay, patient household occupancy, patient educational attainment, employment status, insurance payer, number of recent hospital admissions, number of medications, patient coping ability, level of cognition, team-communication, patient-team communication, new day of discharge team, team professional experience, number of float staff, communication quality, RN Education, teams’ perception of safety, and Taskwork SMM Accuracy).

The model with the smallest AICc was chosen after six steps. Table 22 provides an overview of each step including the variable entered/removed, \(F\) value, overall significance level of model, AICc, and change in AICc. The analysis resulted in the Quality of Transition Baseline Model (baseline model with no interactions or transformed variables). In addition to the six forced in variables, an additional seven variables were selected: team professional experience, number of recent hospital admissions, new day of discharge team, patient employment status, patient age, and patient gender.
Table 22

Multiple Regression Stepwise Selection Process for the Baseline Model of the Quality of Transition Outcome

<table>
<thead>
<tr>
<th>Step</th>
<th>Variables Included (+) &amp; Excluded (-)</th>
<th>DF</th>
<th>F</th>
<th>p</th>
<th>AICc</th>
<th>AICc Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Model 1 (Forced-in Variables)(^a)</td>
<td>9, 32</td>
<td>8.39</td>
<td>&lt; .0001</td>
<td>337.729</td>
<td>.</td>
</tr>
<tr>
<td>1</td>
<td>+ Patient Employment Status</td>
<td>10, 31</td>
<td>9.43</td>
<td>&lt; .0001</td>
<td>333.729</td>
<td>4.000</td>
</tr>
<tr>
<td>2</td>
<td>+ Patient Marital Status</td>
<td>11, 32</td>
<td>10.36</td>
<td>&lt; .0001</td>
<td>330.768</td>
<td>2.961</td>
</tr>
<tr>
<td>3</td>
<td>+ Number of Admissions</td>
<td>12, 29</td>
<td>11.48</td>
<td>&lt; .0001</td>
<td>327.718</td>
<td>3.049</td>
</tr>
<tr>
<td>4</td>
<td>+ Team Professional Experience</td>
<td>13, 28</td>
<td>15.41</td>
<td>&lt; .0001</td>
<td>317.969</td>
<td>9.750</td>
</tr>
<tr>
<td>5</td>
<td>+ New Team</td>
<td>14, 27</td>
<td>15.92</td>
<td>&lt; .0001</td>
<td>317.942</td>
<td>0.027</td>
</tr>
<tr>
<td>6</td>
<td>+ Patient Gender</td>
<td>15, 26</td>
<td>17.28</td>
<td>&lt; .0001</td>
<td>316.541</td>
<td>1.401</td>
</tr>
</tbody>
</table>

Note. N = 42 Multiple Regression Stepwise Selection Process performed in SAS. The model with the smallest AICc was chosen after six steps. Quality of Transition was measured using CTM-15 (ranging from 0 [poor] to 100 [excellent]). \(^a\)Model 1 (Significant variables from the Quality of Transition Pre-Selection Model) = Teamwork SMM, Taskwork SMM, inpatient unit type, principal diagnosis, patient age, number of comorbidities \(^b\)AICc Δ Difference in AICc compared to Model 1. Positive AICC Δ indicates a better fitting model than the previous step.
Quality of Transition model diagnostics. After variable selection, the Quality of Transition Baseline Model was assessed for potential violations of the four principal assumptions of multiple regression: linearity, homoscedasticity, independence, and normality. First, cumulative function plots were created by plotting the cumulative sums of residuals by each continuous independent variable in the Baseline Model. The cumulative function plots indicated that the relationships were close to linear for each continuous variable (see Appendix G Figure G5). None of the tests for non-linearity were significant, indicating that there is no evidence of any violations of the linearity assumption: Teamwork SMM \( (p = .443) \), Taskwork SMM \( (p = .151) \), patient age centered \( (p = .778) \), number of comorbidities \( (p = .512) \), team professional experience \( (p = .170) \), and number of admissions \( (p = .271) \).

A Q-Q Plot of the Baseline Model’ residuals showed no large violation of the normality assumption (Figure 10). In addition, Shapiro-Wilk’s test for normality was not significant \( (p = .441) \). Scatter plots of residuals versus the predicted values were appropriate and showed no apparent homoscedasticity issues or patterns in the distribution. Lastly, Cook’s Distance (Cook’s D) and DFBETA statistics were used as diagnostics for influential and high-leverage cases. Cook’s D values higher than .30 are problematic, but in our model they ranged from 0 to 0.25, suggesting that there were no problematic outliers (SAS Institute, 2017; Rawlings et al., 1998). Appendix G includes examples of key plots such as the Standardized Pearson’s Residual by Beta plot (Figure G6) and Fit Diagnostics plots (Figure G7) used to evaluate the assumptions of the Quality of Transition Baseline Model.

In summary, no violations of normality, linearity, or homoscedasticity of residuals were found. Therefore values for the Quality of Transition Baseline Model result in the Final the Quality of Transition Model. Figure 11 provides an updated framework for the proposed relationships between discharge teams’ SMMs and patients quality of transition (Aim 2A and Aim 2B).
Figure 10. Q-Q Plot for the Quality of Transition Final Model

Figure 11. Quality of Transition Final Model variables and aims
Final Quality of Transition Model. The final model included the following variables: Teamwork SMMs, Taskwork SMMs, principal diagnosis, unit, patient age, patient gender, patient marital status, patient employment status, number of comorbidities, number of admissions, new day of discharge team, and team level of experience. The coding schemes for the categorical variables includes, inpatient unit type (Medical vs. Cardiology, Orthopedic vs. Cardiology), patient gender (male = 0; female = 1), patient marital status (single = 0; married = 1), employment status (retired = 0; working = 1), new day of discharge team (yes = 1; no = 0), The patient principal diagnosis were by inpatient unit: Cardiology unit (CHF = 0 vs. AMI = 1), Medical unit (COPD = 0 vs. Pneumonia = 1), and Orthopedic unit (Knee replacements = 0 vs. Hip replacement= 1). As previously discussed the following variables are centered to the mean, including: Teamwork SMM (M = 6.11), Taskwork SMM (M = 8.46), and patient age (M = 75.03 years old). Two of the variables are scaled to the standard deviations: Teamwork SMM (SD = 0.38) and Taskwork SMM (SD = 0.91).

Results of the Final Quality of Transition Model. Standard multiple regression analysis revealed that the final model predicts quality of transition well: $F(15, 26) = 17.28$, $p < .001$. $R^2$ for the model was .90, adjusted $R^2$ was .86, and the AICc for the final selected model was 316.54. Table 23 displays the unstandardized coefficients ($b$), standardized coefficients ($\beta$), Standard Error ($SE$), 95% confidence intervals, $t$ value, and level of significance. In terms of individual relationships between the independent variables and quality of transition, Teamwork SMM ($t = 3.94, p = .001$), Taskwork SMM ($t = 3.62, p = .001$), patient age ($t = -3.03, p = .005$), number of comorbidities ($t = -3.06, p = .005$), number of admissions ($t = -4.92, p < .001$), team professional experience ($t = -4.32, p < .001$), experienced discharge team ($t = 2.34, p = .027$), being married ($t = -3.16 p = .004$), working ($t = -4.67 p < .001$). Teamwork and Taskwork SMMs relationships to patient’s quality of transition (measure with the CTM-15) are of particular interest to this study (Aim 2a and 2b).

Teamwork SMM (Aim 2A). There is evidence that the quality of patient’s transitions is statistically significantly related to discharge teams’ Teamwork SMMs, after controlling for the other patient, team, and unit contextual factors in the model ($t = 3.94, p = .001$). That is, for every one standard deviation increase in the discharge teams’ Teamwork SMM points, we expect the patient’s CTM-15 score to increase by 4.6 points, while holding the other patient, team, and unit contextual factors in the model constant.
Taskwork SMM (Aim 2B). There is evidence that patient’s quality of transition is statistically significantly related to discharge teams’ Taskwork SMMs, after controlling for the other patient, team, and unit contextual factors in the model ($t = 3.94, p = .001$). That is, for every one standard deviation increase in the discharge teams’ Teamwork SMM score, we expect the patient’s CTM-15 score to increase by 5.9 points, while holding the other patient, team, and unit contextual factors in the model constant.
Table 23
Regression Analysis Summary of the Final Quality of Transition\(^{a}\) Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>(b)</th>
<th>SE</th>
<th>(p)</th>
<th>(t)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM(^c)</td>
<td>4.63</td>
<td>3.94</td>
<td>.001</td>
<td>3.94</td>
<td>[2.22, 7.04]</td>
</tr>
<tr>
<td>Taskwork SMM</td>
<td>5.95</td>
<td>3.62</td>
<td>.001</td>
<td>3.62</td>
<td>[2.57, 9.32]</td>
</tr>
<tr>
<td>Age(^c)</td>
<td>-0.61</td>
<td>-3.03</td>
<td>.005</td>
<td>-3.03</td>
<td>[-1.02, -0.20]</td>
</tr>
<tr>
<td># Comorbidities</td>
<td>-1.50</td>
<td>-3.06</td>
<td>.005</td>
<td>-3.06</td>
<td>[-2.51, -0.49]</td>
</tr>
<tr>
<td># Admissions</td>
<td>-7.25</td>
<td>-4.92</td>
<td>&lt;.001</td>
<td>-4.92</td>
<td>[-10.28, -4.23]</td>
</tr>
<tr>
<td>Team Experience</td>
<td>-1.25</td>
<td>-4.32</td>
<td>&lt;.001</td>
<td>-4.32</td>
<td>[-1.85, -0.66]</td>
</tr>
<tr>
<td>New Discharge Team (Yes)</td>
<td>6.00</td>
<td>2.34</td>
<td>.027</td>
<td>2.34</td>
<td>[0.73, 11.27]</td>
</tr>
<tr>
<td>Marital Status (Single)</td>
<td>-11.83</td>
<td>-3.16</td>
<td>.004</td>
<td>-3.16</td>
<td>[-19.52, -4.14]</td>
</tr>
<tr>
<td>Employment (Retired)</td>
<td>-17.74</td>
<td>-4.67</td>
<td>&lt;.001</td>
<td>-4.67</td>
<td>[-25.55, -9.92]</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>-5.68</td>
<td>-2.20</td>
<td>.037</td>
<td>-2.20</td>
<td>[-11.00, -0.36]</td>
</tr>
<tr>
<td>Medical Unit (Cardiology)</td>
<td>-16.86</td>
<td>-3.78</td>
<td>.001</td>
<td>-3.78</td>
<td>[-26.02, -7.70]</td>
</tr>
<tr>
<td>Pneumonia (COPD)</td>
<td>10.48</td>
<td>2.20</td>
<td>.037</td>
<td>2.20</td>
<td>[0.70, 20.27]</td>
</tr>
<tr>
<td>Orthopedic Unit (Cardiology)</td>
<td>8.89</td>
<td>4.55</td>
<td>.062</td>
<td>1.95</td>
<td>[-0.46, 18.25]</td>
</tr>
<tr>
<td>Hip (Knee)</td>
<td>-13.16</td>
<td>3.40</td>
<td>.001</td>
<td>-3.87</td>
<td>[-20.14, -6.18]</td>
</tr>
<tr>
<td>Cardiology Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHF (AMI)</td>
<td>-9.01</td>
<td>-1.8</td>
<td>.053</td>
<td>-2.03</td>
<td>[-18.14, 0.13]</td>
</tr>
</tbody>
</table>

*Note. N = 42  \(^{a}\)Quality of Transition was measured using CTM-15 \(^{c}\)Centered to the Mean \(^{s}\)Scaled to Standard Deviation. The patient principal diagnosis were by inpatient unit: Cardiology unit (CHF = 0 vs. AMI = 1), Medical unit (COPD = 0 vs. Pneumonia = 1), and Orthopedic unit (Knee replacements = 0 vs. Hip replacement = 1). *\(p < .05\)
Quality of transition interaction testing. In addition to examining if Teamwork and Taskwork SMMs were related to the quality of transition, Aim 2A and Aim 2B sought to examine if the relationships were modified by the Teamwork SMM Convergence, Taskwork SMM Convergence, and Taskwork Accuracy. To examine if the SMM properties modified the relationship three interaction terms were created: Teamwork SMM Convergence x Teamwork SMM (Aim 2a), Taskwork SMM Convergence x Taskwork SMM (Aim 2b), and Taskwork Accuracy x Taskwork SMM (Aim 2b). To test for significance for each moderation effect, individual regression analysis that included the interaction terms were performed using SAS PROC REG. An interaction term was considered to be significant if it lowered the AICc (i.e., an AICc < 316.541 would indicate a better fit than the Final Model). These results are displayed in Table 24. No significant interactions were found.

Teamwork SMM interaction (Aim 2Ai). There is no evidence that the quality of patient’s transitions outcome is statistically significantly related to the degree of Teamwork SMM convergence after controlling for the other variables in the model, \( b = -2.69, \text{ Wald } \chi^2(22, n = 42) = 0.04, p = .833 \). The Teamwork SMM Convergence x Teamwork SMM interaction is not statistically significant after controlling for the other variables in the model, \( B = -6.37, \text{ Wald } \chi^2(21, n = 42) = 0.60, p = .439 \). This indicates that there is no evidence that the degree of Teamwork SMM Converge affects the quality of patient’s transitions differently depending on the Teamwork SMM score. Last, adding Teamwork SMM Convergence (as well as the interaction term between Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the Final the Quality of Transition Model by 6.195 and 12.47 points respectively, suggesting that the original model is a better fit.

Taskwork SMM Convergence interaction (Aim 2Bi). There is no evidence that the quality of patient’s transitions is statistically significantly related to the degree of Taskwork SMM Convergence \( (B = 12.95 \text{ Wald } \chi^2 [22, n = 42] = 0.97, p = .325) \), after controlling for the other variables in the Model 2. The Taskwork SMM Convergence x Taskwork SMM interaction is not statistically significant \( (b = -.23, \text{ Wald } \chi^2 [21, n = 42] = p = .986) \); there is no evidence that the degree of Teamwork SMM Converge affects the CTM differently depending on the Teamwork SMM score. Last, adding Teamwork SMM Convergence (as well as the interaction term between Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the Final the Quality of Transition Model by 6.195 and 12.47 points respectively, indicating that the original model is a better fit.
**Taskwork Accuracy interaction (Aim 2Bii).** There is no evidence that the quality of patient’s transitions is statistically significantly related to the degree of Taskwork SMM Convergence (\( b = 12.95 \text{ Wald } \chi^2 [22, n = 42] = 0.97, p = .325 \)), after controlling for the other variables in the Model 2. The Taskwork SMM Convergence x Taskwork SMM interaction is not statistically significant (\( b = -.23, \text{ Wald } \chi^2 [21, n = 42] = .04, p = .986 \)); there is no evidence that the degree of Teamwork SMM Converge affects the CTM differently depending on the Teamwork SMM score. Last, adding Teamwork SMM Convergence (as well as the interaction term between Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the Final the Quality of Transition Model by 6.195 and 12.47 points respectively, indicating that the original model is a better fit.
Table 24
Summary of Results Testing Regression of the Quality of Transition Final Model with Teamwork SMM Convergence, Taskwork SMM Convergence, Taskwork Accuracy, and Interaction Terms

<table>
<thead>
<tr>
<th>Interactions</th>
<th>B</th>
<th>SE</th>
<th>Wald Chi-Square</th>
<th>p</th>
<th>AICC</th>
<th>AICC Δb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM Convergence</td>
<td>-2.69</td>
<td>12.76</td>
<td>.04</td>
<td>.833</td>
<td>322.736</td>
<td>6.195</td>
</tr>
<tr>
<td>Teamwork SMM Convergence x Teamwork SMM</td>
<td>-6.37</td>
<td>8.23</td>
<td>.60</td>
<td>.439</td>
<td>328.948</td>
<td>12.407</td>
</tr>
<tr>
<td>Taskwork SMM Convergence</td>
<td>12.95</td>
<td>13.16</td>
<td>.97</td>
<td>.325</td>
<td>321.824</td>
<td>5.283</td>
</tr>
<tr>
<td>Taskwork SMM Convergence x Taskwork SMM</td>
<td>-.23</td>
<td>13.45</td>
<td>.00</td>
<td>.986</td>
<td>328.630</td>
<td>12.089</td>
</tr>
<tr>
<td>Taskwork Accuracy</td>
<td>-.93</td>
<td>1.43</td>
<td>.42</td>
<td>.516</td>
<td>322.360</td>
<td>5.819</td>
</tr>
<tr>
<td>Taskwork Accuracy x Taskwork SMM</td>
<td>-.22</td>
<td>1.12</td>
<td>.04</td>
<td>.845</td>
<td>322.742</td>
<td>6.201</td>
</tr>
</tbody>
</table>

Note. aTeamwork SMM Convergence, Taskwork SMM Convergence, Taskwork Accuracy, and their respective interaction terms were individually tested for the effect on Quality of Transition outcome (CTM-15 score), while controlling for the following variables of the Final Model: Teamwork SMM, Taskwork SMM, inpatient unit type, principal diagnosis, patient age, number of comorbidities team professional experience, number of recent hospital admissions, new day of discharge team, patient employment status, patient age, and patient gender. bAICC Δ is the difference between the AICc for the Final Model (316.541) and the AICc for the Interaction Model’s AICc. Negative AICC Δ indicates a better fitting model.
Utilization of Unplanned Medical Services Model

In order to answer the research questions for Aim 2, logistic regression(s) were performed in SAS. Utilization of unplanned medical services (UUMS) from 58 discharge events were analyzed, including 18 patients who reported an UUMS, and 40 patients who did not have an UUMS. Similar to the quality of transition model, a modified AICc stepwise procedure was used to develop a logistic model for UUMS outcome. The following sections provide an overview of the modeling selection process (key covariate predictor selection, and modified stepwise selection), model diagnostics (model assumptions and evaluation of fit tests), and model testing (regression analysis and interaction evaluation).

Utilization of Unplanned Medical Services model selection. Variable prescreening prior to the stepwise selection phase proceeded similarly for the UUMS outcome as it did for the Quality of Transition models (see Figure7).

Key covariate predictor selection. Due to the small sample size, only three predictor variables (Teamwork SMM, Taskwork SMM, and Inpatient unit type) were forced into the model. The focus of Aim 2 is to examine the relationship(s) between the patient’s use of UUMS and the discharge team’s Teamwork SMMs (Aim 2a), as well as Taskwork SMMs (Aim 2b). These relationships were analyzed via PROC LOGISTIC in SAS.

The omnibus likelihood ratio test comparing the model containing the three variables of interest, to a model where only the intercept was included, was statistically significant Wald $\chi^2 (4, n = 58) = 9.90, p = .042$. This indicates that at least one of these variables is important in predicting UUMS. The Receiver Operating Characteristic (ROC) curve for UUMS has an area under the curve (AUC) of .79, which would suggest the model with Teamwork SMMs, Taskwork SMMs, and inpatient unit type is a good discriminator of using vs. not using unplanned medical services (Rao, 2003). Table 25 shows the logistic regression coefficient ($\beta$), SE, likelihood ratio 95% confidence limits, Wald $\chi^2$ values and $p$ values. The AICc value for this model was 69.3.
Table 25
Logistic Regression Pre-Selection Phase Model Predicting Utilization of Unplanned Medical Services from Discharge
Team Shared Mental Models (SMMs) and Patient's Inpatient Unit Type

<table>
<thead>
<tr>
<th>Predictor</th>
<th>b</th>
<th>SE</th>
<th>95% CI</th>
<th>Wald $\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.13</td>
<td>.58</td>
<td>[-2.40, -.06]</td>
<td>3.76</td>
<td>.052</td>
</tr>
<tr>
<td>Teamwork SMM cs</td>
<td>-.68</td>
<td>.41</td>
<td>[-1.55, .08]</td>
<td>2.77</td>
<td>.096</td>
</tr>
<tr>
<td>Taskwork SMM cs</td>
<td>.18</td>
<td>.39</td>
<td>[-.57, 1.00]</td>
<td>.22</td>
<td>.638</td>
</tr>
<tr>
<td>Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>1.21</td>
<td>.74</td>
<td>[-.19, 2.75]</td>
<td>2.69</td>
<td>.101</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>-.95</td>
<td>.99</td>
<td>[-3.10, .95]</td>
<td>.91</td>
<td>.340</td>
</tr>
<tr>
<td>Cardiology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $N = 58$ *Centered to the Mean* *Scaled to Standard Deviation.*
**Modified stepwise model selection.** In the logistic regression framework, an AICc modified stepwise approach was conducted in SAS via PROC HPGENSELECT. This process identified other key predictors for the UUMS outcome. The UUMS and quality of transition used the same potential predictor variables during the model selection process.

Due to the limited sample size of the UUMS outcome, the model selection phase was somewhat restricted by convergence and identifiability issues. As a result, only three variables of interest (Teamwork SMM, Taskwork SMM, inpatient unit) were forced into the AICc stepwise selection process at each step. The AICc from Step 0 in the model was 69.35 (see Table 26). In each subsequent step, all variables were then considered for addition (or removal) until there was no longer a potential improvement/decrease of the model’s AICc.

Table 26 provides an overview of the AICc stepwise selection process. A total of two steps were completed and the final model included an additional two variables: quality of communication and the number of comorbidities. After model selection, the UUMS model with selected variables using the stepwise procedure was labeled as the UUMS Baseline Model (no variable transformations or interaction terms). To determine the relationship between these variables and the UUMS outcome, another logistic regression model was created via PROC LOGISTIC in SAS. The model overall likelihood ratio significance test was significant, Wald $\chi^2 (6, n = 58) = 13.95, p = .030$. The ROC curve for UUMS has an AUC of .85, which would suggest the UUMS Baseline is very good discriminator of using vs. not using unplanned medical services. The AICc for this model was 64.80.

<table>
<thead>
<tr>
<th>Step</th>
<th>Variables Included (+) &amp; Excluded (-)</th>
<th>Utilization of Unplanned Medical Services</th>
<th>$p$</th>
<th>AICc</th>
<th>AICc $\Delta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Model 0a (Forced-in Variables)</td>
<td>p</td>
<td></td>
<td>69.345</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>+ Communication Quality</td>
<td>.025</td>
<td>66.95</td>
<td>2.395</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>+ Number of Comorbidities</td>
<td>.027</td>
<td>64.80</td>
<td>4.547</td>
<td></td>
</tr>
</tbody>
</table>

*Note. n = 58 aModel = Teamwork SMM, Taskwork SMM, inpatient unit bAICc $\Delta$ Difference in AICc compared to Model 0 (69.345). Positive AICc $\Delta$ indicates a better model than the previous step.*
Unplanned Utilization of Medical Services model diagnostics. After variable selection, the UUMS Baseline Model was assessed for potential violations of the principal assumptions of multiple logistic regression. A ROC curve was constructed and the AUC was used to estimate the diagnostic accuracy of the model (see Figure 12 below). The AUC of .857 indicates an excellent overall accuracy (SAS Institute, 2017; Rawlings et al., 1998). The Hosmer-Lemeshow goodness-of-fit test was not significant \( \chi^2 (8, n = 58) = 12.48, p = .131 \), which indicates that the final model does not show evidence of lack of fit. DFBETA statistics were used as diagnostics for influential and leverage cases. The index plots of the Pearson’s residuals and the deviance residuals were used to identify influence observations. Appendix G provides the residual and DFBETAS (Figure G8) and Standardized Residual (Figure G9) plots used to evaluate the fit diagnostics for Model of the UUMS outcome.

Collinearity diagnostics of the logistic model was performed in SAS using the PROC COLLINDIAG statement and the condition index was examined. The collinearity between the raw communication quality and the intercept was found to be higher than 10, suggesting concerns for multicollinearity (Condition Index = 45.3). The descriptive statistics and the distribution of the model were examined. Notably the range of the communication quality is restricted (varying only from 4.2 to 7) and the standard deviation (0.6) is smaller than the other predictors variables in the model. Additionally, the communication quality distribution was positively skewed: Because of the limited variation in the communication quality variable, as well as collinearity with the intercept, the communication quality variable was re-parametrized. The variable was rescaled to reflect the poor communication by subtracting the observed scores by the best possible score on the scale (a score of 7). The collinearity diagnostic test with the re-scaling of the communication quality variable (or poor communication) showed an improved Condition Index (9.8) indicating that it was appropriate to include in the model.

In summary, our final model showed no evidence of lack of fit, and there were no large outliers or influential points. Re-scaling the communication quality variable as poor communication addressed the issue with multicollinearity.
Figure 12. The ROC Curve for unplanned utilization of medical services (UUMS) outcome. The curve assumes that the overall accuracy prediction of occurrence of UUMS based on the logistic regression model. In order to estimate the probability that a patient will UUMS based on certain characteristic is a formula derived from the coefficients of the UUMS Model 1. The ROC curve plots sensitive against (1 – specificity) for each possible probability of UUMS within 30 days of hospital discharge were obtained using UUMS Final Model.

Final Unplanned Utilization of Medical Services Model. The Final UUMS Model included the following variables: Teamwork SMMs, Taskwork SMMs, inpatient unit, number of comorbidities and communication quality. To aid in the interpretation of the model, some of the variables were centered, rescaled, and re-parametrized. As previously discussed, the Teamwork SMM and Taskwork SMM were centered to the mean and scaled to the standard deviation ($M = 6.11, SD = 0.38$; vs. $M = 8.46, SD = 0.91$, respectively). The number of comorbidities was centered to the mean (5.25). Due to the distribution of communication quality, the communication quality variable was re-centered so that the
intercept would be interpreted at the highest score possible for the communication scale (7); therefore, each 1 unit increase in poor communication is a 1 unit decrease from 7 in communication quality. The medical unit was set as the baseline inpatient unit. With these modifications, the exponentiated intercept refers to the odds of having an unplanned utilization of medical services at the mean Teamwork SMM score, mean Taskwork SMM score, mean number of comorbidities, and the highest score of communication quality in the Medical Unit. Figure 13 provides an overview of the relationships between the discharge teams’ SMMs and unplanned utilization of medical services 30-day after hospitalization.

**Figure 13. Utilization of Unplanned Medical Services Final Model variables and aims**

**Results of the Unplanned Utilization of Medical Services Final Model.**

Multiple logistic regression analysis revealed that the final model significantly predicted UUMS using the global likelihood test Wald $\chi^2 (6, n = 58) = 13.95, p = .030$. The ROC for the model was .857 indicates an excellent overall accuracy, and the AICc for the final selected model was 64.7. Table 27 displays the unstandardized coefficients ($B$), Standard Error ($SE$), 95% confidence intervals, Wald $\chi^2$ value, and level of significance. In terms of individual relationships between the independent variables and UUMS, number of comorbidities (Wald $\chi^2 (1, n = 58) = 4.09, p = .043$), communication quality (Wald $\chi^2 (1, n = 58) = 5.17, p = .023$), being on the Cardiology (Wald $\chi^2 (1, n = 58) = 4.35, p = .037$) were significantly related to the UUMS, while holding the other patient, team, and contextual factors in the model constant. Teamwork and Taskwork SMMs relationships to 30-day UUMS are of particular interest to this study (Aim 2a and 2b).
Table 27
Logistic Regression Analysis Summary of the Final Unplanned Utilization Model

<table>
<thead>
<tr>
<th>Predictor</th>
<th>( b )</th>
<th>( SE )</th>
<th>Wald ( \chi^2 )</th>
<th>( p )</th>
<th>Point Estimate</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM(^c)</td>
<td>-0.09</td>
<td>0.53</td>
<td>0.03</td>
<td>.867</td>
<td>0.92</td>
<td>0.33</td>
<td>2.58</td>
</tr>
<tr>
<td>Taskwork SMM(^c)</td>
<td>0.81</td>
<td>0.51</td>
<td>2.52</td>
<td>.113</td>
<td>2.24</td>
<td>0.83</td>
<td>6.09</td>
</tr>
<tr>
<td>Orthopedic Unit (vs. Medical)</td>
<td>-1.84</td>
<td>1.04</td>
<td>3.13</td>
<td>.077</td>
<td>0.16</td>
<td>0.02</td>
<td>1.22</td>
</tr>
<tr>
<td>Cardiology Unit (vs. Medical)</td>
<td>-2.03</td>
<td>0.97</td>
<td>4.35</td>
<td>.037*</td>
<td>0.13</td>
<td>0.02</td>
<td>0.89</td>
</tr>
<tr>
<td>Comorbidities(^c)</td>
<td>0.29</td>
<td>0.14</td>
<td>4.09</td>
<td>.043*</td>
<td>1.33</td>
<td>1.01</td>
<td>1.76</td>
</tr>
<tr>
<td>Communication Quality(^d)</td>
<td>2.30</td>
<td>1.01</td>
<td>5.17</td>
<td>.023*</td>
<td>9.96</td>
<td>1.37</td>
<td>72.20</td>
</tr>
</tbody>
</table>

Note: \( N = 58 \) \(^c\)Centered to the Mean \(^c\)Scaled to Standard Deviation. \(^d\) Adapted measures from Millward and Jeffries (2001) Team Survey were used to determine Communication Quality and Teamwork Quality (ranging from 0 [poor] to 7 [excellent]). Re-centered so that the intercept would be interpret at the highest score possible for the communication scale (7); therefore, each 1 unit increase in poor communication is a 1 unit decrease from 7 in communication quality. * \( p < .05 \)
**Teamwork SMM (Aim 2A).** In the final model, a one standard deviation increase in Teamwork SMM score decreases the odds of utilizing an unplanned medical service by a factor multiple of .915 while holding Taskwork SMM score, communication quality, inpatient unit, and the number of comorbidities constant. However, this relationship is not statistically significant, Wald \( \chi^2 (1, n = 58) = .867, p = .877 \). Therefore, in this model, there is insufficient evidence to conclude that UUMS is related to discharge teams’ Teamwork SMMs.

**Taskwork SMM (Aim 2B).** In the final model, a one standard deviation increase in Taskwork SMM score would increase the odds of utilizing an unplanned medical service by a factor multiple of 2.24 while holding everything else in the model as constant. However, the relationship is not statistically significant, Wald \( \chi^2 (1, n = 58) = 2.518, p = .113 \). Therefore, in this model, there is insufficient evidence that UUMS is related to discharge teams’ Taskwork SMMs.

**Unplanned Utilization of Medical Services interaction testing.** In addition to examining if Teamwork and Taskwork SMMs were related to the UUMS, Aim 2A and Aim 2B sought to examine if the relationships were modified by the Teamwork SMM Convergence, Taskwork SMM Convergence, and Taskwork Accuracy. To examine if the SMM properties modified the relationship three interaction terms were created: Teamwork SMM Convergence x Teamwork SMM (Aim 2a), Taskwork SMM Convergence x Taskwork SMM (Aim 2b), and Taskwork Accuracy x Taskwork SMM (Aim 2b). To test for significance for each moderation effect, individual logistic regression analysis that included the interaction terms were performed using SAS PROC LOGISTIC. An interaction term was considered to be significant if it lowered the AICc (i.e., an AICc < 64.7 would indicate a better fit than the Final Model). These results are displayed in Table 28.

**Teamwork SMM convergence interaction (Aim 2Ai).** There is insufficient evidence that UUMS is related to the degree of Teamwork SMM convergence after controlling for the other variables in the UUMS Final Model, \( b = -.372 \), Wald \( \chi^2 (1, n = 58) = .47, p = .492 \). The Teamwork SMM Convergence x Teamwork SMM interaction is also not statistically significant in the model, \( b = -.210 \), Wald \( \chi^2 (1, n = 58) = .31, p = .580 \). This indicates that there is insufficient evidence to conclude that the degree of Teamwork SMM Convergence affects the odds of UUMS differently depending on the Teamwork SMM score. Last, adding Teamwork SMM Convergence (as well as the interaction term between
Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the UUMS Final Model by 2.22 and 4.72 points respectively, suggesting that the UUMS Final Model is a better fit.

**Taskwork SMM Convergence interaction (Aim 2Bi).** There is insufficient evidence that UUMS is related to the degree of Taskwork SMM Convergence \( (b = .20 \text{ Wald } \chi^2 [1, n = 58] = <.00, p = .972) \), after controlling for the other variables in the Model. The Taskwork SMM Convergence x Taskwork SMM interaction is not statistically significant \( (b = .57, \text{ Wald } \chi^2 (1, n = 58) = .02 p = .887) \); there is no evidence that the degree of Teamwork SMM Convergence affects the UUMS differently depending on the Teamwork SMM score.

Last, adding Teamwork SMM Convergence (as well as the interaction term between Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the UUMS Final Model by 2.70 and 5.49 points, respectively, indicating the UUMS Final Model is a better fit.

**Taskwork Accuracy interaction (Aim 2Bii).** There is no evidence that the UUMS is statistically significantly related to the degree of Taskwork SMM Convergence \( (b = .08 \text{ Wald } \chi^2 [1, n = 58] = .02, p = .881) \), after controlling for the other variables in the Final UUMS Model. The Taskwork SMM Convergence x Taskwork SMM interaction is not statistically significant \( (b = .58, \text{ Wald } \chi^2 (1, n = 58) = .71 p = .399) \); there is no evidence that the degree of Teamwork SMM Converge affects the UUMS differently depending on the Teamwork SMM score. Last, adding Teamwork SMM Convergence (as well as the interaction term between Teamwork SMM Convergence and Teamwork SMM) increased the AICc of the UUMS Final Model by 2.68 and 4.77 points respectively, indicating that the original model is a better fit.
Table 28

Summary of Results Testing Regression of the Unplanned Utilization Final Model with Teamwork SMM Convergence, Taskwork SMM Convergence, Taskwork Accuracy, and Interaction Terms

<table>
<thead>
<tr>
<th>Testing Interactions</th>
<th>b</th>
<th>SE</th>
<th>LL</th>
<th>UL</th>
<th>Wald $\chi^2$</th>
<th>p</th>
<th>AICC</th>
<th>AICC $\Delta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork SMM Convergence</td>
<td>-3.72</td>
<td>5.41</td>
<td>-14.33</td>
<td>6.89</td>
<td>.47</td>
<td>.492</td>
<td>67.01</td>
<td>2.22</td>
</tr>
<tr>
<td>Teamwork SMM Convergence x Teamwork SMM</td>
<td>-2.10</td>
<td>3.79</td>
<td>-9.53</td>
<td>5.33</td>
<td>.31</td>
<td>.580</td>
<td>69.52</td>
<td>4.72</td>
</tr>
<tr>
<td>Taskwork SMM Convergence</td>
<td>.20</td>
<td>5.81</td>
<td>-11.19</td>
<td>11.59</td>
<td>&lt;.00</td>
<td>.972</td>
<td>67.50</td>
<td>2.70</td>
</tr>
<tr>
<td>Taskwork SMM Convergence x Taskwork SMM</td>
<td>.57</td>
<td>4.00</td>
<td>-7.27</td>
<td>8.41</td>
<td>.02</td>
<td>.887</td>
<td>70.29</td>
<td>5.49</td>
</tr>
<tr>
<td>Taskwork Accuracy</td>
<td>.08</td>
<td>.53</td>
<td>-.97</td>
<td>1.13</td>
<td>.02</td>
<td>.881</td>
<td>67.47</td>
<td>2.68</td>
</tr>
<tr>
<td>Taskwork Accuracy x Taskwork SMM</td>
<td>.58</td>
<td>.69</td>
<td>-7.8</td>
<td>1.95</td>
<td>.71</td>
<td>.399</td>
<td>69.57</td>
<td>4.77</td>
</tr>
</tbody>
</table>

Note. $^a$Teamwork SMM Convergence, Taskwork SMM Convergence, Taskwork Accuracy, and their respective interaction terms were individually tested for the effect on Unplanned Utilization, while controlling for the following variables of the Final Model: Teamwork SMM, Taskwork SMM, inpatient unit type, number of comorbidities. $^b$AICC $\Delta$ is the difference between the AICc for the Final Model (64.7) and the AICc for the Interaction Model’s AICc. Negative AICC $\Delta$ indicates a better fitting model.
Overview of Results

Aim 1 Results

Teams’ Average Teamwork SMM and Teamwork SMM Convergence (Aim 1A) Summary. Overall, the discharge teams reported relatively high quality Teamwork SMMs ($M = 6.11$ out of $7, SD = 0.39$) and Teamwork SMM Convergence ($M = .85, SD = .10$) among the RN, MD, and DC on the day of hospital discharge. Discharge teams’ with higher quality of Teamwork SMMs scores report having a greater shared understanding of members roles/responsibilities, knowledge of team members skills and abilities, and awareness of who, what and when to communicate key information to each other as compared with lower scores. Determining the degree of Teamwork SMMs Convergence provides insight into how much the members agree on the quality of Teamwork SMM for each discharge team. The degree of Teamwork SMM Convergence ranged from $.55$ to $1$, indicating that team members varied from low levels of agreement to perfect agreement on the quality of Teamwork SMM.

Teams’ Average Taskwork SMM and Taskwork SMM Convergence (Aim 1A, 1B) Summary. Overall the discharge teams reported relatively high levels of Taskwork SMMs ($M = 8.46$ out of $10, SD = .91$) and Taskwork SMM Convergence ($M = .90, SD = .10$) among the RN, MD, and DC on the day of hospital discharge. High Taskwork SMM scores indicate that the discharge team perceived that patients were ready for hospital discharge. Determining the degree of Taskwork SMMs convergences provides insight into how much the members agree on the patient’s level of readiness for hospital discharge (Taskwork SMM) for each discharge team. Although the majority of discharge teams’ reported that their patients were ready for hospital discharge, the scores ranged from $.66$ to $1$, which suggests that some discharge teams had lower levels of agreement on how ready the patient was to go home.

Inpatient Unit Comparisons (Aim 1C) summary. To identify if the measurements for Teamwork and Taskwork SMMs were sensitive to various unit types, a series of separate ANOVAs were used to compare the three inpatient unit scores of Teamwork SMMs, Teamwork SMM Convergences, Taskwork SMMs, and Taskwork SMM Convergences. The inpatient units significantly differed in their Teamwork SMM, Teamwork SMM Convergence, Taskwork SMM, as well as Taskwork SMM Convergence scores. In particular, the Teamwork SMM mean scores for the Medical unit and the Cardiology unit
were significantly lower than the Orthopedic unit. The Medical unit’s mean Teamwork SMM Convergence, Taskwork SMM, and Taskwork SMM Convergence scores were all significantly lower than the Orthopedic unit’s scores. The Medical unit differs from the Orthopedic unit in potentially meaningful ways as described below; the implications of this are discussed in Chapter 5.

The patients sampled on the Orthopedic unit all had planned admissions for hip ($n = 11$) or knee ($n = 10$) surgery without an ICU admission. The majority of patients sampled from the Orthopedic unit were married, and reported high levels of expected support. Prior to admission, the patients were evaluated by the surgeon in the clinic and were given educational materials on what to expect during the hospitalization. The hospitalization period for patients was standardized and included a similar checklist of activities that needed to be completed each day. Additionally, the Orthopedic unit has received multiple quality of care awards for their hip and knee patient, and had an experienced staff of nurses, nurse assistance and physical therapists with relatively low staff turnover.

In comparison, the Medical unit provides care to a wide variety of patient populations from acute infection (like pneumonia; $n = 11$) to chronic diseases (like COPD; $n = 11$). All Medical unit patients had unexpected hospital stays, and three were admitted to the ICU prior to being transferred to the Medical unit. Unlike the Orthopedic unit, of the Medical unit patients sampled 45.5% ($n = 10$) reported being single with only a moderate level of expected support at home ($M = 5.5$). Additionally, the staff (RN, MD, DC) from the Medical unit were younger and less experienced than those on the Orthopedic unit.

**Aim 2 Result Summary**

**Teamwork SMMs and patient post-hospitalization outcomes (Aim 2A) summary.** This pilot study found that the quality of a patient's transition (as measured using the CTM-15) is statistically significantly related to the discharge teams’ Teamwork SMM, after controlling for key patient characteristics (age, number of comorbidities, number of admissions, marital status, employment status), team characteristics (team professional experience, team past experiences working with the patient, and Taskwork SMM), and inpatient unit type ($t = 3.94, p = .001$). Notably, discharge teams’ Teamwork SMMs were positively associated with the CTM-15 score, while holding the other patient, team, and unit contextual factors in the model constant.
However there is insufficient evidence to support that the degree of Teamwork SMM Convergence affects the quality of patient’s transitions differently depending on the Teamwork SMM score (Aim 2Ai; $B = -6.37$, Wald $\chi^2 [21, n = 42] = 0.60$, $p = .439$). Likewise, although multiple logistic regression analysis revealed that the final model significantly predicted UUMS using the likelihood ratio test, there is insufficient evidence to conclude that UUMS is related to discharge teams’ Teamwork SMMs (Aim 2A; Wald $\chi^2 [1, n = 58] = .867$, $p = .877$). Lastly, there is insufficient evidence to conclude that the degree of Teamwork SMM Convergence affects the odds of UUMS differently depending on the Teamwork SMM score (Aim 2Ai; $b = -2.10$, Wald $\chi^2 [1, n = 58] = .31$, $p = .580$).

**Taskwork SMMs and patient post-hospitalization outcomes (Aim 2B)**

**Summary.** This pilot study found evidence that patients’ quality of transition is statistically significantly related to discharge teams’ Taskwork SMMs, after controlling for the other patient, team, and unit contextual factors in the Final Quality of Transition Model ($t = 3.94$, $p = .001$). Discharge teams’ Taskwork SMM was found to be positively associated with the CTM-15 score, while holding the other patient (age, number of comorbidities, number of admissions, marital status, employment status), team (team professional experience, team past experiences working with the patient, and Teamwork SMM), and inpatient unit type contextual factors in the model constant.

However, there is insufficient evidence to support that the degree of Taskwork SMM Convergence (Aim 2Bi; $b = -.23$, Wald $\chi^2 [21, n = 42] = .986$) or Taskwork SMM Accuracy (Aim 2Bii; $b = -.23$, Wald $\chi^2 [21, n = 42] = .04$, $p = .986$) affects the quality of patient transitions differently depending on the Taskwork SMM score. There is also insufficient evidence to conclude that UUMS is related to discharge teams’ Taskwork SMMs, after controlling for inpatient unit type, number of comorbidities, Teamwork SMM, and communication quality (Aim 2B; Wald $\chi^2 [1, n = 58] = .867$, $p = .877$). Lastly, in the Final UUMS Model, the Taskwork SMM Convergence x Taskwork SMM interaction was not statistically significant (Aim 2Bi; $b = .57$, Wald $\chi^2 [1, n = 58] = .02$, $p = .887$), and the Taskwork SMM Convergence x Taskwork SMM interaction was not statistically significant (Aim 2Bii; $b = .58$, Wald $\chi^2 [1, n = 58] = .71$, $p = .399$).

**Summary**

This chapter provided the results for each aim and research question. The next section will discuss the implications of these results in the larger context of the literature.
CHAPTER 5
DISCUSSION AND CONCLUSIONS

The purpose of this prospective longitudinal pilot study was to examine the content of SMMs (taskwork and teamwork) among the inpatient discharge team members and the influence of SMMs on patients’ 30-day post-hospitalization outcomes (quality of transition and utilization of unplanned medical services). In the following chapter, a brief review of problem, study design, and results are offered, followed by discussion of the results as they pertain to advancing the science, practice, and new research directions.

Review of the Problem

Post-hospitalization safety is a major concern for patients, providers, and policymakers. Nearly one in five older adults experience an adverse event after hospital discharge (Forster et al., 2003; Forster et al., 2004). Lapses in teamwork among inpatient healthcare providers at the time of hospital discharge places older adults at increased risk for costly delays, unmet patient needs, adverse events, and preventable readmissions (AHRQ, 2012; Nosbusch, Weiss, & Bobay, 2011). Preparing patients for discharge requires multiple tasks that cross professional boundaries (Aase, Schibevaag, & Waring, 2017; Greysen et al., 2012; Kripalani, Jackson, Schnipper, & Coleman, 2007; Waring, Marshall, & Bishop, 2015). This creates a high-risk situation of role ambiguity and diffuse responsibility among healthcare providers (Waring et al., 2015). Without a shared understanding among members of the healthcare team regarding the patient’s situation and the individual team members’ roles, lapses in care can occur, further placing patients at increased risk for harm post-hospitalization (Popejoy, Moylan, & Galambos, 2009; Waring et al., 2015). It has been suggested that the quality of team-based care affects patient post-hospitalization outcomes, yet there is a gap in our understanding of how healthcare team processes impact patient post-discharge outcomes (Greysen et al., 2012; Pinelli, Papp, & Gonzalo, 2015; Popejoy et al., 2009; Waring et al., 2015).

This study applies a concept from organizational psychology, shared mental model, to examine how providers coordinate complex discharge tasks as a team (Mohammed et al., 2010). Healthcare teams discharging patients can simultaneously hold multiple SMMs that contain different types of relevant knowledge, including Teamwork SMMs (roles and
responsibilities involved in discharging patients) and Taskwork SMMs (how ready the patient is for discharge; Cooke, Salas, Cannon-Bowers, & Stout, 2000; Mohammed, Hamilton, & Lim, 2009). A key property of SMMs is convergence, or the level of agreement among team members (Mohammed et al., 2009). Military research shows that teams with more convergent and accurate SMMs have higher teamwork capacity and performance (Cannon-Bowers, Salas, & Converse, 1990; DeChurch & Mesmer-Magnus, 2010). These findings suggest that discharge teams with more convergent Teamwork and Taskwork SMMs may contribute to improved patient outcomes (DeChurch & Mesmer-Magnus, 2010). However, little is known about how knowledge is organized among inpatient discharge teams and whether provider SMMs are associated with patient’s outcomes.

**Review of Study Design and Analysis**

To address these gaps in the literature a prospective longitudinal pilot study was conducted at a single hospital site in Iowa City, IA. A total of 64 discharge events were enrolled across three inpatient units. On the day of hospital discharge, patients completed a questionnaire with demographic information and the Readiness for Hospital Discharge Scale (RHDS). Providers completed a questionnaire containing demographic information, team characteristics, the Discharge Provider-Readiness for Hospital Discharge Scale/Short Form (DP-RHDS/SF), and the Shared Mental Models Scale. Approximately 30 days after hospital discharge, either by phone or by mailed questionnaire, the post-hospitalization outcome data were collected from the patient. The quality of transition was measured using the Care Transition Measure (CTM-15). Additionally, during the follow-up, patients reported if they utilized unplanned medical services, which was defined as returning unexpectedly to the emergency room and/or being admitted to the hospital within 30 days post-discharge. An overview of the study procedures can be found in Figure 6 of Chapter 3.

Aim 1 of this study was to determine the degree of convergence for discharge teams’ Teamwork SMMs and Taskwork SMMs on three inpatient hospital units (N = 64). Provider’s IMMs of teamwork were measured using the Shared Mental Models Scale, while Taskwork IMMs were measured using the DP-RHDS/SF. By averaging the individual scores on these measures, individual team member’s mental models were aggregated to create the new team-level cognitive structure of Teamwork SMMs (Aim 1A) and Taskwork SMMs (Aim 1B). The degree of convergence was determined by calculating the $r^{*}_{wg(j)}$ for the Teamwork SMM (Aim 1A) and Taskwork SMM (Aim 1B). Additionally, separate ANOVAs
were conducted to compare the effects of the three inpatient unit types on Teamwork SMMs, Teamwork SMMs, Teamwork SMM Convergence, and Taskwork SMM Convergence (Aim 1C).

Aim 2 of this study was to determine the relationship between discharge teams’ Teamwork SMMs and Taskwork SMMs on three inpatient hospital units and the patients’ 30-day post-hospitalization outcomes, including the quality of transition (n = 42) and utilization of unplanned medical services (n = 56), while controlling for contextual unit and patient characteristics. A modified AICc stepwise model selection procedure was used to identify a Final Quality of Transition Model with 12 predictors to examine the relationships between Teamwork SMMs and Taskwork SMMs and the Quality of Transition outcome, including six key variables (Teamwork SMMs, Taskwork SMMs, principal diagnosis, unit, patient age, and number of comorbidities), and six additional stepwise selected variables (gender, marital status, employment status, number of admissions, new day of discharge team, and team level of experience). After model diagnostics, the relationship of Teamwork SMMs and Taskwork SMM to the quality of transition was determined using standard regression analysis (Aim 2A). A second modified AICc stepwise model selection procedure informed the development of the Final Utilization of Unplanned Medical Services Model, including three key variables of interest (Teamwork SMM, Taskwork SMM, inpatient unit) and two additional stepwise selected variables (number of comorbidities and communication quality). After performing model diagnostics, the relationship(s) of Teamwork SMMs and Taskwork SMM to utilization of unplanned medical services was determined using logistic regression analysis (Aim 2B). Finally, for both models the effects of the proposed interactions of interest – Teamwork SMM x Teamwork SMM Convergence (Aim 2Ai), Taskwork SMM x Taskwork SMM Convergence (Aim 2Bi), and Taskwork SMM x Taskwork Accuracy (Aim 2Bii) – on the patients’ 30-day post-hospitalization outcomes were examined.

Aim 1 Results Summary

For Aim 1 measures were piloted to determine the Teamwork SMM, Teamwork SMM Convergence, Taskwork SMM, and Taskwork SMM Convergence scores for 64 unique discharge teams.

Teamwork SMM and Teamwork SMM Convergence Summary (Aim 1A)

The day of discharge teams reported relatively high quality Teamwork SMMs (M = 6.11 out of 7, SD = 0.39) and Teamwork SMM Convergence (M = .85, SD = .10, Max/Min
Discharge teams with higher quality Teamwork SMMs scores reported having a greater shared understanding of members' roles/responsibilities, knowledge of team members' skills and abilities, and awareness of who, what, and when to communicate key information to each other as compared with teams with lower scores. Although the majority of discharge teams' reported a high quality Teamwork SMM, the scores ranged from .55 to 1, which suggests that some discharge teams had lower levels of agreement on the quality of Teamwork SMMs.

**Taskwork SMM and Taskwork SMM Convergence Summary (Aim 1B)**

The discharge teams reported high levels of Taskwork SMMs ($M = 8.46$ out of 10, $SD = .91$) and Taskwork SMM Convergence ($M = .90$, $SD = .10$, $Max/Min = .66/1$) in this sample. Higher Taskwork SMM scores indicate that the discharge team perceived that patients were ready for hospital discharge. Although the majority of discharge teams' reported that their patients were ready for hospital discharge, the scores ranged from .66 to 1, which suggests that some discharge teams had lower levels of agreement on how ready the patient was to go home.

**Inpatient Unit Comparisons Summary (Aim 1C)**

ANOVA revealed that the inpatient units significantly differed in their Teamwork SMM, Teamwork SMM Convergence, Taskwork SMM, as well as Taskwork SMM Convergence scores (Aim 1C). In particular, the mean Teamwork SMM score for the Medical unit and the Cardiology unit was significantly lower than the Orthopedic unit. The Medical unit’s mean Teamwork SMM Convergence, Taskwork SMM, and Taskwork SMM Convergence scores were all significantly lower than the Orthopedic unit’s scores.

**Aim 2 Results**

Aim 2 of this pilot study was to examine the relationships between SMMs and patient post-hospitalization outcomes.

**Teamwork SMMs and Patient Post-Hospitalization Outcomes (Aim 2A)**

This pilot study found the quality of a patient’s transition (as measured using the CTM-15) is positively associated with the discharge teams’ Teamwork SMM, after controlling for key patient characteristics (age, number of comorbidities, number of admissions, marital status, employment status), team characteristics (team professional experience, team past experiences working with the patient, and Taskwork SMM), and inpatient unit type ($t = 3.94, p = .001$). There is insufficient evidence to conclude that a)
degree of Teamwork SMM Convergence affects the quality of patient’s transitions differently depending on the Teamwork SMM score (Aim 2Ai), b) utilization of unplanned medical services is related to discharge teams’ Teamwork SMMs (Aim 2A), or c) Teamwork SMM Convergence affects the odds of utilization of unplanned medical services differently depending on the Teamwork SMM score (Aim 2Ai).

**Taskwork SMMs and Patient Post-Hospitalization Outcomes (Aim 2B)**

Discharge teams’ Taskwork SMM was found to be positively associated with the CTM-15 score, while holding the other patient (age, number of comorbidities, number of admissions, marital status, employment status), team (team professional experience, team past experiences working with the patient, and Teamwork SMM), and inpatient unit type contextual factors in the model constant (Table 23). However, there is insufficient evidence to support that a) the degree of Taskwork SMM Convergence (Aim 2Bi) or Taskwork SMM Accuracy (Aim 2Bii) affects the quality of patient’s transitions differently depending on the Taskwork SMM score, or b) utilization of unplanned medical services is related to discharge teams’ Taskwork SMMs (Aim 2B), after controlling for inpatient unit type, number of comorbidities, Teamwork SMM, and communication quality. In the Final Utilization of Unplanned Medical Services Model, neither the Taskwork SMM Convergence x Taskwork SMM interaction (Aim 2Bi), nor the Taskwork SMM Convergence x Taskwork SMM interaction were statistically significant (Aim 2Bii).

**Advancing Science**

Due to frequent adverse events, costly hospital readmissions, and unmet patient needs in the post-hospitalization, there is a critical need to reexamine how healthcare teams prepare patients to transition safely from the hospital to home (AHRQ, 2012). It is imperative to have an understanding of (and be able to measure) how a healthcare team’s ability to work together impacts patient outcomes (Ashbrook et al., 2013; Greysen et al., 2012). This study sought to advance science by using an innovative approach from organizational psychology to examine the relationships between interprofessional team SMMs on patient post-hospitalization outcomes.

**Conceptual Framework: Interprofessional Teams’ SMMs and Hospital Discharge**

This dissertation advances science by proposing a conceptual model to explain how the effectiveness of inpatient teams is related to patient post-hospitalization outcomes. The role of specific team processes during hospital discharge have not been rigorously examined,
despite poor teamwork being frequently cited as a major root cause of poor post-hospitalization outcomes (Ashbrook et al., 2013; Goodman et al., 2013; Waring et al., 2016), as well as national regulatory organizations advocating for hospitals to provide team-based patient-centered discharge planning (AHRQ, 2014). One of the greatest barriers to studying healthcare team effectiveness is the lack of theoretical frameworks that link targetable team processes to patient outcomes (Masner et al., 2015). This conceptual model (the Interprofessional Teams’ SMMs and Hospital Discharge) was developed by integrating concepts from McGrath’s IPO model and Meleis’s Transition theory, as well as the patient safety and SMM literature. A strength of this conceptual model is that it incorporates not only patient characteristics, but also team characteristics and processes to examine the discharge transition (See Chapter 2, Figure 2).

**Piloting SMM & Convergence Measures at Hospital Discharge (Aim 1)**

Examining SMMs of the discharge team provides an innovative approach to examining how interprofessional teams work in healthcare and addresses a key gap in the literature. Current studies about the hospital discharge process do not consistently include all key healthcare team providers, patients, and their shared team and task knowledge (Aase et al., 2017; AHRQ, 2013; Ashbrook et al., 2013; Goodman et al., 2013). Extant literature has focused on individual perceptions, not on the performance of the team as it relates to their shared knowledge of discharge teamwork and taskwork (Ashbrook et al., 2013; Goodman et al., 2013; Nosbusch et al., 2011). Thus, it is possible we do not have a full understanding of (a) provider roles in the discharge team and (b) the entire discharge task (Ashbrook et al., 2013; Pinelli et al., 2015). Aim 1 of this study begins to address these gaps in the literature by developing methods to determine how healthcare knowledge of team and task are distributed among the healthcare team on the day of hospital discharge.

This study is the first to apply the concept and measure SMMs of interprofessional healthcare teams discharging patients. Applying the concept of SMMs to the discharge process is an innovative way to (re)conceptualize care coordination among interprofessional healthcare teams. For example, qualitative research suggested that the quality of SMMs among the RN, MD, and DC may be a critical facilitator or barrier to the inpatient teams’ ability to adequately prepare patients for a safe transition to home (Ashbrook et al., 2013; Goodman et al., 2013; Nosbusch et al., 2011). However providers (as well as researchers and administrators) lack theoretical frameworks and measures to understand the specific team
processes that are inhibiting the delivery of high quality care when discharging patients (Masner et al., 2015). Conceptualizing and measuring discharge teams’ Teamwork SMMs, Teamwork SMM Convergence, Taskwork SMMs, and Taskwork SMM Convergence have unique potential applications to advance science.

**Teamwork SMM advancements.** This study advances science by applying the concept of Teamwork SMMs to the team task of discharging patients, as well as piloting measures to understand how Teamwork SMMs function in discharge teams. Qualitative research examining provider’s perspectives of the discharge suggest that Teamwork SMMs may serve as a facilitator or barrier of the teams’ capacity to safely discharge patients. For example, interviewed healthcare providers identified that the major barrier to adequately prepare patients for a safe transition home is that discharge tasks cross professional boundaries, which creates a situation of role ambiguity and diffuse individual responsibility for completing tasks (Greysen et al., 2012; Waring et al., 2016; Waring et al., 2015). In the team literature, this is a classic example of teams that are working under divergent mental models (or lack a quality SMM; Cannon-Bowers et al., 1993; Mohammed et al., 2010). However, beyond describing the symptoms of poor Teamwork SMMs, this concept had not been applied to or measured for interprofessional discharge teams. Therefore, it was unknown if team quality and convergence of Teamwork SMMs would vary for the task of discharging patients from the hospital to home.

For this pilot study, the quality and convergence of Teamwork SMMs was measured for 64 unique interprofessional discharge teams in real-time (clinical practice) during the high-risk task of discharging patients (Aim 1A). Measuring Teamwork SMM scores provides an indicator of the quality of discharge teams’ Teamwork SMMs or the level of capacity of the discharge team to effectively coordinate patient care when discharging patients. This study found that the majority of discharge teams’ had high quality Teamwork SMMs ($M = 6.11$ out of $7$, $SD = 0.39$). However, as shown in Figure G1, there were some discharge teams that had higher and lower Teamwork SMM quality (Aim 1A); and mean Teamwork SMM scores differed between inpatient unit types (Aim 1C). These findings are supported by previous qualitative studies that have suggested that teams may vary in their level of agreement on aspects of teamwork such as communication, understanding of roles, and agreement on which team members are responsible different tasks (Coleman et al., 2013;
In addition to identifying the quality of Teamwork SMMs, Teamwork SMM Convergence was determined for each discharge team. Determining Teamwork SMMs Convergence provides insight into how much the members agree on the quality of Teamwork SMM for each discharge team (e.g., individual team members provided similar scores on the Shared Mental Model Scale about the team). As shown in Figure G2, in the sample the Teamwork SMM Convergence scores ranged from low levels of agreement to perfect agreement on the quality of Teamwork SMM (Aim 1A). These preliminary results indicate that there are not only differences in the quality of Teamwork SMMs between discharge teams, but also at times between the individual team members. Additionally, discharge teams’ average degree of converges differed between inpatient unit types (Aim 1C). This highlights the complexity of studying interprofessional teams and supports the need to examine the discharge process from a team perspective. Although additional investigation is needed to determine if teams with low levels of convergence are at high risk for providing lower quality patient care, findings from qualitative research suggests that discharge teams that lack a shared understanding among the team members limits their ability to provide effective care (Coleman et al., 2013; Fuji et al., 2013; Goldman et al., 2015; Greysen et al., 2012; Hesselink 2013; Jiang et al., 2016; Waring et al., 2016).

**Taskwork SMMs advancements.** This study advances science by applying the concept of (and measuring) Taskwork SMMs to the discharge process. The concept of Taskwork SMMs is useful for understanding how knowledge about a patient’s situation is distributed among an interprofessional team during the discharge process. In order for the healthcare team to have the maximum capacity to prepare patients for a safe transition from the hospital to home, it is suspected that the members of the healthcare team should share a similar understanding of the patient’s readiness for hospital discharge (McComb et al., 2012; Miller et al., 2009). However, assessment of the patient’s readiness for hospital discharge has traditionally been thought of as a task completed by individual providers (or as perceptions of individual patients), rather than an important team task. No previous study has examined or measured the discharge teams’ Taskwork SMM or degree of Taskwork SMM Convergence.
This study piloted a measurement approach to determine the Taskwork SMM scores and the degree of Taskwork SMM Convergence for 64 unique discharge teams using the individual provider’s scores on the DP-RHDS/SF. Overall the discharge teams reported relatively high levels of Taskwork SMMs and Taskwork SMM Convergence among the RN, MD, and DC on the day of hospital discharge. High Taskwork SMM scores indicate that the discharge team perceived that patients were ready for hospital discharge. However, determining the degree of Taskwork SMM Convergence provides insight into how much the members agree on the patient’s level of readiness for hospital discharge for each discharge team. Although the majority of discharge teams reported that their patients were ready for hospital discharge, the variation in Taskwork SMM Convergence scores indicates that some discharge teams had lower levels of agreement on how ready the patient was to go home (see Figure G4). Findings from qualitative studies suggest that when providers do not see eye to eye on a patient’s situation (e.g., care plan, patients coping ability, expected home support) there is an inadequate communication among team members and the patient is at risk for poor post-hospitalization outcomes (Greysen et al., 2012; Hesselink 2013; Jiang et al., 2016; Waring et al., 2016). This is the first study to measure Taskwork SMMs and Taskwork SMMs Convergence for RNs, MDs, and DCs, and provides early support for assessing patient readiness for hospital discharge from a team perspective.

**Linking Discharge Team’s SMMs & Post-Hospitalization Outcomes (Aim 2)**

SMMs are suspected to be integral to team-implicit coordination in healthcare; however, little is known about whether and how team distribution of shared knowledge impacts teams’ ability to prepare patients for a safe transition home (Ashbrook et al., 2013). SMMs are a team coordinating mechanism and may be vital to understanding and improving healthcare team performance. The consequences of SMMs are suspected to be closely linked to improving healthcare teamwork and patient safety; however, these relationships remain largely theoretical and under-examined (Custer et al., 2012; McComb & Simpson, 2013; Westli et al., 2010). Aim 2 of this pilot study begins to examine the relationships between SMMs and patient post-hospitalization outcomes.

**Quality of Transition.** A unique finding of this pilot study is that the quality of the discharge teams’ Teamwork SMMs were positively associated with the CTM-15 score, while controlling for other key patient, team, and unit contextual factors for the discharge events sampled (Aim 2A). The CTM-15 measure was developed as a patient-centered outcome
measure to assess the care transition from hospital to home. The content of the CTM-15 focuses on the hospital provider’s actions that were completed to prepare the patient for discharge, and assumes that the CTM-15 is impacted by the quality of care provided by the inpatient team (Coleman et al., 2015). Notably, this is one of the first studies to show initial support that the CTM-15 varies depending on the quality of teamwork among the inpatient healthcare team. In addition, this pilot study also found evidence that patient quality of transition is statistically significantly related to discharge teams’ Taskwork SMMs, after controlling for the other patient, team, and unit contextual factors in the Final Quality of Transition Model (Aim 2B).

**Unplanned Utilization of Medical Services.** Although utilization of unplanned medical services was included as a 30-day patient outcome for this study, there is insufficient evidence to conclude that utilization of unplanned medical services is related to discharge teams’ Teamwork SMMs (Aim 2A) or Taskwork SMMs (Aim 2B). Other studies have found associations between nurse-rated readiness for hospital discharge (i.e., individual nurse taskwork mental models) and hospital readmission (Weiss et al., 2013; Weiss et al., 2011); however, no study has previously examined the discharge teams’ Taskwork or Teamwork SMMs and their relationships with outcomes such as utilization of unplanned medical services. The causes of readmissions, post-hospitalization adverse events, and unmet patient needs are complex and the exact causes are poorly understood (Alper, O’Malley, Greenwald, Aronson, & Sokol, 2013; Bull, 2000; Connolly et al., 2009; Holland & Hemann, 2011; Mistiaen et al., 2007; Moore et al., 2011; Naylor, 2002; Slieper et al., 2007). Only a few research studies have been able to link system factors (e.g., lack of coordination, miscommunication, and unstandardized discharge practices) to patient post-discharge outcomes such as discharge adverse events and hospital readmissions (Anthony et al., 2005; Forster et al., 2003; Goodman et al., 2013; Horwitz et al., 2013; Jiang et al., 2016). The majority of these studies have examined these system level factors retrospectively using root cause analysis or qualitative interviews. An advantage of this study is that it provides a unique approach to prospectively examine the relationship between a team process and patient utilization of unplanned medical services. However, there is insufficient evidence to conclude that utilization of unplanned medical services is related to discharge teams’ Teamwork SMMs (Aim 2A) and Taskwork SMMs (Aim 2B) as a result of this pilot study.
Practice and Research Implications

Post-hospitalization safety is a major concern for patients, providers, and policymakers. Nearly one in five older adults experience an adverse event after hospital discharge (Forster et al., 2003; Forster et al., 2004). Addressing health system factors placing older adult patients at risk for adverse outcomes, including readmission to acute care settings, could result in $12 billion in annual Medicare savings (Medicare Payment Advisory Commission, 2009). CMS, The Joint Commission, and AHRQ have identified avoidable readmissions as one of the leading problems that the U.S. healthcare system faces. Reducing avoidable hospital readmissions presents an actionable opportunity for providers, healthcare system administrators, insurance payers, and policymakers to work together to reduce overall healthcare costs while simultaneously increasing the quality of patient care (AHRQ, 2012; Gerhardt et al., 2013; Medicare Payment Advisory Commission, 2009). The following sections will provide preliminary implications of this study for quality improvement, administrators, bedside practitioners, and researchers.

Implications for Quality Improvement

This study has practical implications for evaluating quality improvement projects and interventions aimed at improving the discharge process. Methods to examine interprofessional team SMMs are needed to evaluate team-based interventions. Team-based interventions to improve patient transition to home include rounds/huddles, checklists, standardization/role delineation of the discharge process, and interprofessional or patient-centered care plans (AHRQ, 2012; Kripalani et al., 2007; Mitchell et al., 2017; Nosbusch et al., 2011; Parry et al., 2008). All of these interventions aim to increase inpatient team shared understanding of patient readiness for discharge and/or team role in discharge. However, it is difficult to evaluate the fidelity of team-based interventions because the field lacks methods to determine how healthcare providers share knowledge of team and tasks (Greysen et al., 2012; McDonald et al., 2007; Nosbusch et al., 2011). This study developed and tested an approach for measuring discharge teams’ SMMs that can be used in practice and research to evaluate team-based interventions.

Implications for Administrators

In addition to evaluating quality improvement projects, healthcare administrators may find several aspects of this dissertation useful for clinical practice, including the conceptual framework proposed (Interprofessional Teams’ SMMs and Hospital Discharge,
Figure 2), the methodological approach to measuring discharge teams’ SMMs, and preliminary findings.

In work environments that require teams of individuals to complete complex tasks, investigating one person’s individual mental model will only provide information from one person’s perspective. As this study shows, when examining cognition related to team-dependent tasks, it is necessary to examine the collective knowledge held by the team (Cooke et al., 2000). This study identified that discharge teams differ in their level of agreement on the quality of their Teamwork SMM (level of capacity to coordinate care), as well as their Taskwork SMM (understanding of patient readiness for hospital discharge). These preliminary results suggest that it is important to think about the discharge process from a team perspective rather than a profession-specific perspective. In practice, much of the efforts aimed at improving the discharge process occur in professional silos with attempts to fix profession-specific tasks. For example, pharmacists may focus on improving medication reconciliation, physicians may focus on improving discharge summaries, while nurses may focus on improving patient educational materials (Bowles et al., 2012; AHRQ, 2014; Weiss et al., 2010). These standardization efforts of the discharge process are all important and useful; however, if thought of from an interprofessional shared mental model lens, it becomes apparent they are examples of tasks that cross interprofessional boundaries and require the entire team’s engagement/understanding in order to implement and provide individualized patient-centered care.

To optimize team performance there is a need to think about the discharge process from an interprofessional team perspective. Examples of potential ways that administrators can examine the discharge process from an interprofessional team perspective might include engaging representatives from multiple professions on quality improvement teams, as well as creating opportunities in practice for providers to exchange ideas in a safe environments (e.g., huddles, rounds, common work spaces). Administrators and nurse managers may also consider using the measurement methods described in this study as a way to capture a snapshot of the discharge process from an interprofessional team perspective on their own inpatient unit. By sampling a small number of discharge events, the manager could begin to answer four important quality improvement questions: 1) As a team do we think we are discharging patients who are ready to go home? 2) As a team do we agree that the patients are ready to discharge? 3) Do we work well as a team to discharge patients? and, 4) Do we
agree on how well we worked as a team to discharge patients? By asking these four questions from a team perspective, a more targeted nuanced approach can be used to improve the discharge process.

**Implications for Bedside Providers**

Readying patients for discharge is a time-sensitive, high-risk task requiring multiple healthcare professionals to concurrently assess the individual patient’s needs; work with the patient to formulate a care plan; provide education; and arrange transportation, home services, equipment, and medications. Several studies have found that healthcare providers want a more in-depth understanding of the discharge process so they can understand how their role fits into providing high-quality discharges for patients (Fuji et al., 2013; Greysen et al., 2012; Waring et al., 2016). Yet Lyndon et al. (2012) explained that nurses and physicians in practice may be unaware that they have divergent views related to patient diagnosis, patient plan of care, and their professional roles in the team, which would limit the team’s capacity to provide safe patient centered care. This pilot study may bring awareness of these potential divergent understandings by providing evidence that some discharge teams differ in their level of agreement on the quality of discharge teams Teamwork SMMs, as well as Taskwork SMMs.

**Implications for Research**

This study has several implications for future research. The conceptual model that illustrates the relationships between SMMs and patient post-discharge outcomes can be used and tested by other investigators interested in understanding the discharge process from an interprofessional perspective (Chapter Two, Figure 2). Additionally, this study provides a protocol and measures for examining inpatient team processes during hospital discharge. The next section will discuss the key research implications for this study, including the limitations and future areas of research.

**Demographic and sample considerations.** This study is intended as a pilot, therefore additional research is needed to generalize these findings to the larger intended population (Viechtbauer et al., 2015). The findings of this study should be interpreted in light of several limitations. First, discharge events were recruited from patients with six principal conditions on three inpatient units at a single Midwestern hospital; discharge events in other inpatient units, patient conditions types, or composed of different types of providers, may differ. Although the patient demographic of the sample was comparable to
the local community’s demographics, the small, homogeneous patient sample limited the analysis by preventing inclusion of key patient variables (such as race/ethnicity, or planned/unplanned admission). The participant inclusion criteria focused on a narrow population: 1) \( \geq 65 \) years, 2) community-dwelling prior to hospitalization, 3) discharged directly home without home health services or hospice care, and 4) admitted with a principal diagnosis of heart failure (HF), acute myocardial infarction (AMI), hip replacement, knee replacement, pneumonia, or chronic obstructive pulmonary disease (COPD). Therefore it is possible that patients that are younger, have different home disposition statuses, and/or different conditions may have discharge teams' with different quality of Teamwork and Taskwork SMMs. For example, the planned and unplanned admissions were directly related to the inpatient unit type: all participants who had a planned admission were from the orthopedic unit. Additional studies should include a wider range of patient conditions.

**Team member considerations.** Future studies should consider who is important to include on the team depending on the patient’s reason for hospital admission and/or unit type. Kozlowski and Bell’s (2003) definition of team was used to apriori identify the discharge team. Kozlowski and Bell (2003) describe teams as a collective of people who perform relevant tasks in an organization, interact socially, share task interdependencies, and have a common goal. To determine the members of the discharge team, a review of the discharge literature, transition theories, and an informal task analysis of the discharge process was used. This pilot study limited the discharge team to the RN, MD, and DC; however, depending on the patient population, including additional team members such as physical therapists, respiratory therapists, and cardiac rehab educators would provide valuable information about knowledge is dispersed among the interprofessional team. As a follow up to this study, qualitative interviews with providers will be used in order to better understand how (and if) healthcare providers work as a team on the day of hospital discharge, as well as who (or if) the the providers consider as apart of the discharge team.

Also, due to the small number of DCs, these providers participated in multiple discharge events (with one DC participating in up to 16 events). There is a possibility that the DC could have an unknown biasing effect on the results. To examine the effect of including the DC on the team, a future step of this study will be to perform an additional analysis that determines the convergence scores between the RN and MD only, which will then be compared to the teams with that include the DC (Waltz, Strickland, & Lenz, 2010).
However, a particular strength of this study is that each discharge team had a unique team composition (no two discharge teams had the same nurse, physician, and discharge coordinator).

**Social desirability considerations.** Due to the nature of the concepts, the assessments of the discharge teams Teamwork and Taskwork SMM depended on self-report and the perceptions of providers. Thus, social desirability bias could have led participants to exaggerate or minimize their responses to the questionnaires. Social desirability is “the tendency of individuals to project favorable images of themselves during social interactions” (Waltz et al., 2010, p. 433). To help minimize socially desirable responses, strategies such as informing the providers that the majority of the data would be aggregated to the team and unit level provider to protect anonymity were used (Waltz et al., 2010). Additionally, participants were informed that individual level provider data would not be reported back to their employer, and that their fellow team members would not see the results from individual discharge events. Last, providers were given an envelope to put the completed survey to keep their responses private (Waltz et al., 2010).

**Model selection consideration.** Because of the exploratory nature of this pilot study, a large number of discharge event variables (patient and team characteristics) were considered during the model selection phase of analysis. As outlined in Chapters 3 and 4, the model selection process involved preliminary evaluation of each variable for appropriateness, identification of key variables from the literature, using regression analysis to select key covariate predictors, and using a modified stepwise section procedure to identify the baseline models for testing. One of the known challenges of using the stepwise procedure is that the automatic variable selection algorithms do not take into consideration prior clinical knowledge or information concerning the effects of factors (Greenland & Pearce, 2015; Kadane & Lazar, 2004). However, prior knowledge and theory can be used to ensure that relevant variables that are selected a priori can be forced-in to the model (Greenland & Pearce, 2015; Kadane & Lazar, 2004). A strength of the model building process for the Quality of Transition Model was that known relevant patient characteristics variables were controlled for in this model.

However, it is possible that the relationships between SMMs and the patient 30-day post-hospitalization outcomes could differ depending on the variables selected in the model. Additionally, the small sample size did not allow for more sophisticated multivariable
methods of analysis such as Hierarchical Linear Modeling, which would have allowed the data to be clustered by patient conditions within inpatient unit type (Polit & Beck, 2010). Future studies should include additional variables and consider using more sophisticated multivariable methods to examine how Teamwork and Taskwork SMMs are related to post-discharge outcomes.

The Quality of Transition Model adjusted $R^2$ was .86, which suggests that the variables in the Quality of Transition Model explain 86% of the variance in the CTM-15 for the sample. However, this high adjusted $R^2$ should be interpreted with caution, as AICc was used to determine the best fitting model, not $R^2$ (Rawlings, Pantula, & Dickey, 1998; Steyerberg et al., 2001; Kadane & Lazar, 2004; SAS Institute, 2017). In any case, a higher adjusted $R^2$ can be an indicator that the model has high accuracy or that the model is over-fitted (unnecessarily complex due to extraneous explanatory variables; Konishi & Kitagawa, 2008). As discussed in Chapter 3, several steps were taken to prevent model over-fitting, such as carefully assessing the appropriateness of inclusion for categorical/continuous variables and using AICc method for stepwise model selection (e.g., AICc considers both the fit of the model and the number of parameters used; Allen, 2007; Greenland & Pearce, 2015; Konishi & Kitagawa, 2008; Polit & Beck, 2010). However, due to the pilot study nature of this study (smaller sample size and large number of variables), the results from this study are not intended to be generalizable to the rest the population.

**Missing data considerations.** Consistent with other longitudinal studies evaluating 30-day post-discharge outcomes, attrition was substantial, particularly for the quality of transition outcome (Coleman et al., 2005; Mitchell et al., 2017). The sample between those who completed the CTM-15 ($n = 44$) and those who did not ($n = 22$) were compared. As discussed in Chapter 4, notably the two groups did not differ by the majority of patient and team participant characteristics, including readiness for hospital discharge. However, the two samples did differ by marital status, planned admission, team professional experience, team communication quality, RN years of experience, MD years of experience, and teamwork quality. Although the discharge events that were missing the CTM-15 were excluded in analysis in the Quality of Transition Model, these results should still be interpreted in light of this missing data (Polit & Beck, 2010; Wilson & Luek, 2014). Additionally, the small sample size and limited number of utilization of unplanned medical services may have affected some of the variables selected and significance values in the final model (Polit & Beck, 2010).
Validity considerations. A strength of this study is that the identified relationships between SMMs and the inpatient units (Aim 1C) provides some tentative support for construct validity (measuring the concepts of interest) for the Teamwork/Taskwork SMMs and degree of convergences. To identify if the measurements for SMMs were sensitive to various unit types, a series of separate ANOVAs were used to compare the three inpatient unit scores of Teamwork SMMs, Teamwork Convergence SMMs, Taskwork SMMs, and Taskwork SMM Convergences (Aim 1C). The inpatient units significantly differed in their Teamwork SMM, Teamwork SMM Convergence, Taskwork SMMs, as well as Taskwork SMM Convergence scores (See Chapter 4, Table 19b), which could be due to functional and structural expected differences in the unit types. However, due to the multiple differences in patient and team characteristics, the mean scores on the instruments may be due to another variable that was not measured and should be interpreted with caution (Polit & Beck, 2010; Waltz et al., 2010). A next step of this study involves qualitative interviews with providers from each unit to explore the differences in the unit functions and cultures to better understand the results from this pilot study. Future studies should investigate the trends found in this study to further validate the Shared Mental Model Scale and the DP-RHDS/SF in the context of measuring Teamwork and Taskwork SMMs.

Conceptual model considerations. This pilot study proposes a conceptual model with theorized relationships among SMMs, convergence, and patient post-hospitalization outcomes, which can be used and tested by other investigators interested in understanding the discharge process from an interprofessional perspective (Chapter Two, Figure 2). However, due to the small sample size of this pilot study, these proposed relationships have not been fully tested and further follow up studies are needed.

SMM content and convergence considerations. Further studies are also needed to examine the ideal content of discharge team SMMs and how much convergence is needed for effective healthcare teams. An initial review of the literature was used to identify two potentially important contents of discharge teams’ SMMs: knowledge of members’ roles and interactions (Teamwork SMM), and knowledge of the patient’s level of discharge readiness (Taskwork SMM; Cooke et al., 2000; Mohammed et al., 2009; Waring et al., 2015). However, these are only two potential types of SMMs of discharge teams. A next step for this research trajectory is verifying the appropriateness of the SMM content with providers that participate in discharge teams using qualitative interview methods.
Additionally, the degree of convergence among the healthcare team members has implications for coordinating patient-centered care. A critical component of patient-centered interactions is having a shared understanding (convergent SMM) of the patient’s values, needs, and preferences to work with the patient to develop a plan of care (Epstein et al., 2010). However, the level of knowledge overlap needed for effective teamwork in healthcare remains unknown (Cooke et al., 2000; Millward & Jefferies, 2001). Although an SMM can increase team performance, healthcare professionals are highly specialized. There is likely a point at which too much convergence among IMMs could result in “group think” and thus limit the team’s adaptability (Mohammed et al., 2012; Westli, Johnsen, Eid, Rasten, & Brattebo, 2010). Cutrer and Thammasitboon (2012) suggested that too much IMM overlap could prevent some professions from incorporating their knowledge and perspectives into the team SMM, resulting in a limited and inaccurate team understanding of the patient situation. Conversely, if a team does not hold a common understanding of relevant information, they function under divergent IMMs and are unable to coordinate patient care (Mohammed et al., 2012; O’Leary et al., 2010). Future studies should continue to identify the appropriate SMM content, and level of convergence needed for maximum team efficiency.

**Conclusion**

Hospital discharge is a dangerous transition that impacts approximately 35.1 million Americans each year. The quality of the healthcare team working together may impact how safe patients are after they leave the hospital. However, little is known about how much the teamwork between doctors, nurses and discharge coordinators impacts patient’s post-hospitalization outcomes. Shared Mental Models are a useful way to examine how providers coordinate complex discharge tasks as a team (Mohammed, et al., 2010). The purpose of this pilot study was to examine the content of SMMs (taskwork and teamwork) among the inpatient discharge team members and the influence of SMMs on patients’ 30-day post-hospitalization outcomes (quality of transition and utilization of unplanned medical services). An innovative approach from organizational psychology was used in this study to examine the influence of interprofessional team SMMs on patient hospital discharge outcomes.

Piloting methods to measure SMMs are a first step towards identifying and evaluating strategies to assist interprofessional care teams prepare patients for a safe, high-quality, patient-centered hospital discharge. This study is the first to a) simultaneously examine both the Teamwork and Taskwork SMMs of interprofessional healthcare teams,
and b) explore the link between inpatient interprofessional discharge Taskwork and Taskwork SMM on the quality of patient discharge. This study advances healthcare team science in ways that lay the foundation for improving patient safety outcomes following discharge.
REFERENCES


Klein, K. J., & Kozlowski, S. W. (2000). From micro to meso: Critical steps in conceptualizing and conducting multilevel research. Organizational research methods, 3(3), 211-236


APPENDIX A DEFINITIONS

Definitions of Key Terms

**Adverse Event [AE]:** According to the Institute of Medicine (IOM), adverse events involve the “injury caused by medical management rather than the underlying condition of the patient” (IOM, 2000, p. 201).

**Ameliorable Adverse Event:** Adverse events in which the severity could have been substantially reduced if a different action or procedures had been performed or followed (IOM, 2000; Forster et al., 2003).

**Conditions of Transition:** A component of the Meleis’ Transition Theory that is used to the personal and environmental factors that facilitate or inhibit the progression towards a healthy transitions (Meleis et al., 2000).

**Hospital Discharge:** Hospital discharge is both (a) a critical time in patient care that involves physically leaving the hospital and (b) a transitional process that occurs over time (i.e., involves a hospitalization phase, leaving hospital, and post hospitalization phase) (Congdon, 1994; Pethybridge, 2004; Potthoff et al., 1997; Weiss et al., 2007; Weiss et al., 2015).

**Implicit Coordination:** Implicit coordination allows team members to anticipate the actions and needs of others, as well as the ability to adjust behavior without overt communication (Gillespie et al., 2010; McComb et al., 2012; Westli et al., 2010).

**Individual Mental Model [IMM]:** The cognitive mechanisms that allow people to understand the “bigger picture” of the systems in which they live (i.e., communities, families, and work teams) (Rouse & Morris, 1986; DeChurch & Mesmer-Magnus, 2010).

**Input:** Inputs are a component of the Input-Process-Output (IPO) theory and are used to describe the antecedent factors that enable and constrain the team members’ action (McGrath, 1964).

**Input-Process-Output Theory:** McGrath (1964) Input-Process-Output Model is widely used as a descriptive framework to understand the effectiveness and performance of teams in the work place and health services research.
**Interprofessional**: Involving more than one healthcare profession (McCallin, 2001).

**Medical Error**: According to the IOM, medical errors are the “failure of planned action to be completed as intended… or the use of a wrong plan to achieve an aim” (IOM, 2000, p. 210).

**Nature of Transitions**: A component of the Meleis’ Transition Theory used to describe the type, pattern, and properties of transitions (Meleis et al., 2000).

**Output**: Outputs are a component of the Input-Process-Output (IPO) theory that is used to describe the result of the team’s activities including the outcomes of the performance and members’ affective reactions (Ilgen, et al., 2005).

**Patient-Centered Care [PCC]**: PCC is defined as “providing care that is respectful of and responsive to individual’s patients preferences, needs, and values, and ensuring that patient values guide all clinical decisions” (IOM, 2001, p. 40).

**Patient-Centered Outcomes [PCO]**: Outcomes that patients and caregivers deem as meaningful and important (Frank et al., 2012).

**Patient Safety Indicators (PSIs)**: PSIs are standardized algorithms that use inpatient administrative data to flag cases with potentially preventable inpatient AEs attributable to hospital care. PSIs were developed to detect hospital AEs using changes in *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis and procedure codes during a patient’s stay (Mull et al., 2014).

**Pattern of Response**: A component of the Meleis’ Transition Theory used to describe the process and outcome indicators of a healthy transition (e.g., patients’ feelings of confidence and competence, as well as mastery of skills for a healthy transition) (Meleis et al., 2000).

**Post-Hospital Self-Management**: Ability of patient to manage care after hospitalization.

**Preparation for Hospital Discharge**: Hospital discharge preparation encompasses “the multiple care process whereby the patient, family, and receiving care providers become
ready for the discharge and management needs of health needs in a subsequent venue”
(Weiss et al., 2015, p. 607).

**Preventable Adverse Event**: Injury that could have been avoided due to an error or flaw in the system (Forster, 2003; IOM, 2000).

**Preventable Readmission**: According to Goldfield et al. (2008), readmission is considered to be potentially preventable if there is a reasonable expectation that one or more of the following actions could have prevented the rehospitalization: (1) the provision of quality care in the initial hospitalization, (2) adequate discharge planning, (3) adequate post-hospitalization follow up, or (4) improved coordination between inpatient and outpatient health care teams.

**Process**: Processes are a component of the Input-Process-Output (IPO) theory and are used to describe how team inputs are transformed into the outcomes (Ilgen, et al., 2005; Mathieu et al., 2008).

**Quality of Preparation for Post-Hospital Self-Management**: Patient-centered measure that includes: the patient’s critical understanding discharge knowledge, respect for individual differences, preparation for self-management, and a written care plan (Coleman et al., 2005). Assessed using the Care Transition Measure (Coleman et al., 2005).

**Readiness for Hospital Discharge [RHD]**: Weiss and Piacentine defined RHD as “a judgment or perception regarding the patient’s immediate state and perceived abilities that relate to managing care needs in the home environment” (2006, p. 5). RHD can be assessed using the Readiness for Hospital Discharge Scale (RHDS), Nurse-Readiness for Hospital Discharge Scale (RN-RHDS), and MD-Readiness for Hospital Discharge Scale (MD-RHDS).

**Readmission**: CMS (2016) defines readmissions as an admission to a subsection hospital within 30 days of a discharge from the same or another subsection hospital. However, the 30-day time period is currently controversial (Joynt and Ashish, 2012).

**Shared Mental Model [SMM]**: SMM is at the team level and is defined as the team members’ shared understanding and organized knowledge of key elements needed for teams to perform effectively (Cooke, Salas, Cannon-Bowers, 2000).
**SMM Accuracy:** Accuracy represents the correctness of the teams’ SMM compared to what is actually going on (Mohammed et al., 2010; Cannon-Bower et al., 1993).

**SMM Convergence:** Convergence is the degree of overlap (or agreement) among IMMs of the team members (Lim & Klein, 2006).

**SMM Taskwork:** The contents of SMM regarding the task situation (current status, expectations, what needs to be done) (Cooke et al., 2000).

**SMM Teamwork:** The content of SMM that pertains to knowledge of the team members (expertise, preferences, strengths/weaknesses) and team interactions (roles/responsibilities, communication patterns, level of support) (Cooke et al., 2000).

**Taskwork:** According to Mathieu et al. (2008), teamwork describes the “functions that the individual must perform to accomplish the team’s task” (p. 420).

**Transition Theory:** A middle range theory proposed by Meleis’ et al. (2000) that is used to identify and demonstrate the relationship between the essential components of transitions.

**Team:** According to Kozlowski and Bell’s classic definition, teams are “collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity.” (2003, p. 334).

**Teamwork:** According to Mathieu et al. (2008), teamwork “describes the interaction between team members” (p.420).

**Therapeutics:** A component of the Meleis’ Transition Theory used Prevention and promotions actions taken to facilitate the transition experience (e.g., assessment, preparing, and role supplementation) (Meleis et al., 2000).

**Transition:** According to Chick and Meleis (1985) transitions are defined as: “the passage or movement from one state, condition, or place to another” (p. 237
APPENDIX B LETTERS OF SUPPORT

Chief Nursing Officer Letter of Support

January 15, 2016

The Division of Scientific Review
Agency for Healthcare Research and Quality

To Whom It May Concern:

As the Vice President of Nursing/Chief Nursing Officer at Mercy Iowa City, I am pleased to offer my support for Ms. Manges and her proposal, "The Influence of Interprofessional Team Shared Mental Models on the Quality of Patient Hospital Discharge." For the purposes of this project, healthcare providers (nurses, discharge coordinators, and physicians) as well as patients will be recruited from Mercy Hospital.

Over the last six months I have met with Ms. Manges to discuss Mercy's involvement in the study and we are excited to be involved. The aims of this pilot study align closely with Mercy Hospital's organization values of excellence, stewardship, and collaboration in order to provide high quality and compassionate care. I believe that this study not only offers the opportunity for a unique research collaboration with the College of Nursing at The University of Iowa, but in addition the knowledge from this study may better inform our discharge process. We are pleased that you have chosen this setting for the recruitment of research participants.

I understand the scope of our participation will include supporting Ms. Manges in recruiting and inviting healthcare providers and patients to participate in the study after completion of the IRB process. All of us here at Mercy look forward to working with Ms. Manges on this very important research project. If we can be of any assistance to you in the interim, please feel free to contact me at 319-339-3621 or by email at cindy.penney@mercyic.org.

Sincerely,

Cindy Penney, DNP, RN, CENP, NEA-BC
Vice President of Nursing/Chief Nursing Officer

CP/vs
January 15, 2016

The Division of Scientific Review
Agency for Healthcare Research and Quality

To Whom It May Concern:

This letter is written in full support of Ms. Kirstin Manges and her AHRQ R36 grant proposal “The Influence of Interprofessional Team Shared Mental Models on the Quality of Patient Hospital Discharge.” The proposed work by Ms. Manges is extremely timely, as there is growing attention both locally and nationally on finding ways to improve the hospital discharge process.

As the Chief Quality Officer and staff physician at Mercy Iowa City Hospital, I can attest to the feasibility of the proposed approach for recruiting and enrolling providers and patients from Mercy Hospital. Our physician group has been very interested in improving our discharge process, and results from this dissertation have the potential to be quite helpful in moving these quality improvement efforts forward. We will therefore be happy to offer Ms. Manges access to our units for her dissertation study.

I look forward to working with Ms. Manges on this very important research project. If I can be of any further assistance, please feel free to contact me at 319-358-2729 or by email at stephen.scheckel@mercyic.org

Best regards,

Stephen Scheckel, MD, DDS, FACEP
Medical Director, ECU
Chief Quality Officer

SS/vs
Chief Privacy Officer Letter of Support

Date: September 19, 2016

To: The University of Iowa IRB-02:

This is to confirm that we are willing to collaborate with University of Iowa researchers on a research study entitled: The Influence of Interprofessional Team Shared Mental Models on the Quality of Patient Hospital Discharge conducted by UI principal investigator Kirstin Mangels (UI Principal Investigator).

We are aware that the procedures used in this project involve the use and/or disclosure of protected health information (PHI) for research purposes without authorization from the patients at this institution.

We have policies and procedures in place to document our Privacy Board’s approval of a waiver of authorization per 45 CFR 164.512, Uses and disclosures for which an authorization or opportunity to agree or object is not required, specifically 45 CFR 164.512(b), Uses and disclosures for research purposes.

We are also aware of that we must provide to our patients, upon request, an accounting of disclosures of their PHI under a waiver of authorization per 45 CFR 164.528, Accounting of disclosures of protected health information.

This letter confirms that a waiver of authorization has been approved by our Privacy Board for the project named above.

Sincerely,

E. Mccollough
Director Information Systems and Mercy’s HIPAA Privacy and Security Office
Mercy Hospital Iowa City, Iowa
APPENDIX C LETTERS OF SUPPORT TO USE TOOLS

Appendix C1 Author’s Permission to use the Team Survey

Thursday, October 22nd, 2015

Dear Kirstin,

I’m afraid that Lynne Millward has passed away, but I’m sure she would have been happy for you to use the “Team Survey.”

There should be no need to get permission from the journal to use the freely available questionnaire, so I would say you’re good to use it. Certainly do treat this email as official permission from the University of Surrey to use it if that is helpful to you.

Good luck in your research.

Best wishes,
Adrian Banks, PhD
Senior Lecturer
University of Surrey
Email: a.banks@surrey.ac.uk
Phone: 01483 68 9435

UNIVERSITY OF SURREY
Appendix C2 Author's Permission to use the Readiness for Hospital Discharge Survey

October 29th, 2015

Kirstin A. Manges, MSN, RN
University of Iowa
College of Nursing

Dear Miss Kirstin Manges,

As the author of the Readiness for Hospital Discharge Scale (RHDS) and in accordance to our agreement, I give you permission to use the following tools for your dissertation: "Readiness for Hospital Discharge Scale" (RHDS), "Readiness for Hospital Discharge Scale/Short Form" (RHDS/SF), "Physician Assessment Readiness for Hospital Discharge Scale/Short Form" (MD-RHDS or MD-RHDS/SF), "Nurse Form Readiness for Hospital Discharge Scale/Short Form" (RN-RHDS or RN-RHDS/SF).

In exchange you agree to provide me with:
1. A brief description of the study and/or clinical population for which it is used
2. A summary of any results from use of the instrument; for example, reliability coefficients, differences among groups, correlations, predictors, and/or outcomes
3. Where possible, a copy of RHDS/QDTS AND/OR PDCDS data for inclusion in an instrument database for further analysis of psychometric properties (not required for permission to use)
4. A copy of any translation of the instrument into a language other than English or any modifications to the instruments. I will make these available to others with appropriate reference to you.
5. A copy of any publications arising from use of the instruments.

Thank you and good luck with your dissertation grant process. If I can be assistance to you in the interim, please feel free to contact me via email [marianne.weiss@marquette.edu].

Best regards,

Marianne Weiss, DNSc, RN
Wheaton Franciscan Healthcare - St. Joseph / Sister Rosalie Klein Professor of Women's Health
Marquette University College of Nursing
PO Box 1881
Milwaukee, WI, 53201-1881
phone - 414-288-3855
fax - 414-288-1939
cell - 847-514-2798

Clark Hall P.O. Box 1881 Milwaukee, Wisconsin 53201-1881 Telephone (414-288-3803) Fax (414-288-1597)
Research Participants Invited

You may be eligible to participate in a study to learn more about how the inpatient healthcare team prepares patients for self-management at home, if you are:

- A bedside nurse, physician, or discharge coordinator
- Employed at Mercy Hospital, Iowa City
- Caring for elderly patients who are admitted with the following condition(s): congestive heart failure, acute myocardial infarction, pneumonia, chronic obstructive pulmonary disease, hip or knee replacements

In this study, you would be asked to fill out surveys about your experiences with discharging patients. Participation is expected to take 15-20 minutes. Participation is completely voluntary and all data will be kept confidential.

Ms. Manges is a doctoral student working on her dissertation from The University of Iowa College of Nursing. She is conducting a study to examine the impact of interprofessional care coordination on the patient's readiness for discharge and self-care management at home.

If you'd like to know more or are interested in participating, please contact Kirstin Manges at (231) 838-XXXX, or kirstin-manges@uiowa.edu.
Hello (Provider),

My name is Kirstin Manges, and I am a doctoral student at The University of Iowa College of Nursing. Currently I am working on my dissertation – The Transition to Home Study – that aims to examine how the inpatient healthcare team works together to prepare patients for self-management at home.

You are receiving this email because I am interested in working with teams of healthcare providers who discharge patients (i.e., bedside nurses, discharge coordinators, and physicians) at Mercy Hospital in Iowa City, and you maybe eligible to participate.

If you take part in this study, it will involve completing a preliminary background survey, as well as a survey about your experience with discharging a patient. Participation should last approximately 15-20 minutes. All participation is strictly voluntary, with the option to stop at any time. Any personal information you might provide as a participant will be kept confidential.

Your participation will help further understanding about how knowledge is distributed among the interprofessional healthcare team during the discharge process. My goal is to ultimately provide hospitals guidance for improving the transition to home for patients, and therefore improve the quality of patients care.

Please contact me at kirstin-manges@uiowa.edu or 231-838-XXXX if you are interested in participating. You can learn more about my academic affiliation at https://nursing.uiowa.edu/academic-programs/phd/current-students/.

Thank you for your consideration,

Kirstin Manges PhD(c) RN
Doctoral Student
College of Nursing

The Transition to Home Study

University of Iowa
Appendix D3 Patient Handout

Research Participants Invited

You may be eligible to participate in a dissertation study to learn more about how healthcare providers – like your doctor, nurse, and discharge coordinator – work together to prepare patients to transition from the hospital to home, if you are:

☐ A patient at Mercy Hospital, Iowa City
☐ 65 years or older
☐ Lived at home prior to admission
☐ Expected to be discharged directly home without home health services or hospice care
☐ Hospitalized with one of the following conditions: congestive heart failure, acute myocardial infarction, pneumonia, chronic obstructive pulmonary disease, hip replacement, knee replacement

What will happen during this study?

In this study you would be asked to fill out surveys about your experiences as a patient being discharged from the hospital. If you agree to take part in this study, your involvement will last for a total of 20-30 minutes. You will complete one survey prior to leaving the hospital and participate in a follow-up phone call interview 30 days after returning home. Participation is completely voluntary and confidential. You will be paid $5 for each survey completed.

What are the benefits of being in this study?

We hope that this study will further our understanding of how the hospital healthcare team prepares patients to take care of themselves safely at home. The expected outcome of this pilot study is to provide a foundation to help develop evidence-based practices for the healthcare team to improve patient readiness for hospital discharge.

Who is the researcher performing the study?

Ms. Manges is a doctoral student working on her dissertation at The University of Iowa College of Nursing. She is conducting a 4-month long pilot study to examine the impact of interprofessional care coordination on the level of patient’s readiness for discharge and ability of self-care management at home.

If I am interested, what are the next steps?

If you’d like to know more or are interested in participating, please contact Kirstin Manges at (231) 838-XXXX, or kirstin-manges@uiowa.edu.

Thank you for your consideration!
APPENDIX E IRB DOCUMENTS

Appendix E1 Provider Waiver of Consent

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The Transition to Home Study

We invite you to participate in the Transition to Home research study. The purpose of this pilot study is to better understand how healthcare providers – like the nurse, discharge coordinator, and physician – work together to prepare patients for self-care management at home. We hope that this study will further our understanding of how the hospital healthcare team impacts the level of patient readiness to take care of themselves safely at home. The expected outcome of this pilot study is to provide a foundation to help develop evidence-based practices for the healthcare team to improve patient readiness for hospital discharge.

We are inviting you to participate in this research study because you are an inpatient healthcare provider (nurse, discharge coordinator, or physician) at Mercy Hospital in Iowa City. Approximately 60 patients and their inpatient discharge team members (i.e., bedside nurse, discharge coordinator, physician) will take part in this study at the Mercy Hospital in Iowa City.

What will happen during this study?
This study involves surveying patients and their corresponding discharge team members. All provider surveys will be completed at Mercy Hospital in Iowa City. If you take part in this study, you will be asked to fill out two surveys: 1) a Preliminary Survey (i.e., a brief demographic questionnaire) and, 2) the Provider Transition to Home Survey (i.e., a questionnaire that is related to a patient's case).

- **Preliminary Survey:** The preliminary survey is expected to take approximately 5 to 10 minutes to complete and includes questions about your gender, training, role in the discharge process, years of experiences in your profession, in the organization, and in your unit; as well as the major facilitators and barriers to discharging patients. Because the preliminary survey is not related directly to a specific patient discharge event, you can fill out this survey at your convenience in the location of your choice. Surveys can be returned to the researcher in person or via the locked box on the unit.

- **Provider Transition to Home Survey:** You would be asked to complete this survey after a target patient has agreed to study participation. The provider version of the Transition to Home Survey is expected to take approximately 5–10 minutes. Eligible and willing discharge team members will be asked to fill out the Transition to Home Survey on the day the patient is expected to be discharged from the hospital. You may be asked to complete additional discharge event surveys depending on your professional role and if you are caring for other eligible patients. Completing a survey on other participating patients would be completely voluntary and would take approximately 10-15 minutes per patient.

What about confidentiality?
We will keep the information you provide confidential, however federal regulatory agencies and the University of Iowa Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. Efforts will be taken to protect your rights to privacy by collecting the minimum information necessary to meet the aims of this study. To help protect your confidentiality, your responses will be kept confidential, including assignment of ID numbers and physical and electronic security measures. A locked box will be kept on the unit to safely collect surveys. All hard copies will be maintained in a locked box to which only the researcher has access. Notably, if we write a report or article about this study or share the study data set with others, we will do so in such a way that you cannot be directly identified.

Are there any risks to participating?
There are no known potential risks from being in this study beyond what you might experience in your
daily practice. However, there is a risk of emotional stress due to personal disclosure related to work practices of discharging patients. If you experience emotional stress, please notify the researcher who will find someone to whom you can talk, or contact the Mercy Iowa City Human Resources office at 319-339-3267. The researcher is not affiliated with Mercy Hospital and will not be informing the hospital of any individual’s study data. The researcher will help you find ways to anonymously report ongoing patient safety issues if you have concerns. Additionally, any data provided to Mercy Hospital will be presented at the aggregated level with no individual identifiers.

**What are the benefits of participating?**
You will not benefit personally. However, we hope that, in the future, other people might benefit from this study because of your participation. We hope that this study will further our understanding of how the hospital healthcare team impacts the level of patient readiness to take care of themselves safely at home. My goal is to ultimately provide hospitals guidance for improving the transition to home for patients, and therefore improve the quality of patient care. Additionally, the de-identified results will be shared with the Mercy Hospital to help inform their discharge practices.

**Are there any costs?**
You will not have any costs for being in this research study.

**Is there compensation?**
You will not be paid for being in this research study.

**Is being in this study voluntary?**
Taking part in this research study is completely voluntary. If you decide not to be in this study, or if you stop participating at any time, you won’t be penalized or lose any benefits for which you otherwise qualify.

If you have any questions about the research study itself, or if you experience a research-related injury, please contact the principle investigator Kirstin Manges (email: kirstin-manges@uiowa.edu; phone: 231-838-XXXX) and/or the supervising faculty member Patricia Groves (email: patricia-groves@uiowa.edu). If you have questions about the rights of research subjects, please contact the Human Subjects Office, 105 Hardin Library for the Health Sciences, 600 Newton Rd, The University of Iowa, Iowa City, IA 52242-1098, (319) 335-6564, or e-mail irb@uiowa.edu. To offer input about your experiences as a research subject or to speak to someone other than the research staff, call the Human Subjects Office at the number above.

Thank you very much for your consideration. Returning the completed questionnaires will indicate your willingness to participate in the study.

Sincerely,

Kirstin Manges, PhD(c) RN
Appendix E2 Evaluation of Consent

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Evaluation to Sign an Informed Consent Document for Research

Subject Identifier: ____________________________ Date of Evaluation: __________

Directions

Make a subjective judgment regarding item 1. Ask the subject questions 2-5 and record responses. The evaluator may use different wording in asking the questions in order to assist the subject's understanding.

1. Is the subject alert and able to communicate with the examiner? Yes ____ No ____

2. Ask the subject to name a potential risk of participating in the study.

_____________________________________________________________________________________

3. Ask the subject to name at least two things that he/she will be expected to do during the study.

_____________________________________________________________________________________

_____________________________________________________________________________________

4. Ask the subject to explain what he/she would do if he/she no longer wanted to participate in the study.

_____________________________________________________________________________________

_____________________________________________________________________________________

5. Ask the subject to explain what he/she would do if he/she experienced distress or discomfort during the study.

_____________________________________________________________________________________

_____________________________________________________________________________________

Evaluator's Signature

It is my opinion that the subject is alert, able to communicate, and gave acceptable answers to the questions above.

__________________________________________ __________________________ 
Evaluator's Signature Date
Appendix E3 Patient Informed Consent

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INFORMED CONSENT DOCUMENT

Project Title: The Influence of Interprofessional Team Shared Mental Models on the Quality of Patient Hospital Discharge

Principal Investigator: Kirstin Manges

Research Team Contact: Kirstin Manges
Phone: 231-383-3231
Email: kirstin-manges@uiowa.edu

This consent form describes the research study to help you decide if you want to participate. This form provides important information about what you will be asked to do during the study, about the risks and benefits of the study, and about your rights as a research subject.

- If you have any questions about or do not understand something in this form, you should ask the research team for more information.
- You should discuss your participation with anyone you choose such as family or friends.
- Do not agree to participate in this study unless the research team has answered your questions and you decide that you want to be part of this study.

WHAT IS THE PURPOSE OF THIS STUDY?

This is a research study. We are inviting you to participate in this research study because you are a patient being discharged from Mercy Hospital Iowa City to home.

The purpose of this pilot research study is to examine how healthcare providers – like your doctor, nurse, case manager, physical therapist – work together to prepare patients to transition from the hospital to home. We hope that this study will further our understanding of how the hospital healthcare team impacts the level of patient readiness to take care of themselves safely at home. The expected outcome of this pilot study is to provide a foundation to help develop evidence-based practices for the healthcare team to improve patient readiness for hospital discharge.

HOW MANY PEOPLE WILL PARTICIPATE?

Approximately 60 patients and their healthcare providers (i.e., nurse, discharge coordinator, doctor) will take part in this study at Mercy Hospital in Iowa City.

HOW LONG WILL I BE IN THIS STUDY?

If you agree to take part in this study, your involvement will last for 20-30 minutes over two visits.

1. Transition to Home Survey. The first section of the study involves taking a 10-15-minute survey prior to leaving the hospital.
2. Post-Discharge Patient Survey. The second section will take place 30 days after being discharged from the hospital, and will involve a follow-up telephone phone call by the researcher that will last approximately 10-15 minutes. If you can’t be reached by phone, a survey will be mailed to you for you to complete and mail back.
WHAT WILL HAPPEN DURING THIS STUDY?

Becoming enrolled in the study:

- This study involves surveying the patients and their healthcare providers (nurses, discharge coordinators, and doctors).
- As a potentially eligible patient we are inviting you to participate in the study approximately 20 to 48 hours prior to your estimated discharge.
- Then, during the morning of your discharge, the researcher will confirm that both you and your corresponding healthcare team members (bedside nurse, discharge coordinator, and physician) are eligible/willing to participate in the study.
- You will be enrolled in the study if you and all of the discharge team providers consent to participate.
- The researcher will inform you on your day of hospital discharge whether you will or will not be enrolled in the study.

Your involvement as a participant:

- You will be surveyed at two time points: 1) in person on the day you leave the hospital (The Transition to Home Survey) and 2) with a follow-up phone (or a paper) survey 30-days after you leave the hospital.
  
  - **The Transition to Home Survey**
    - On the morning that you are expected to go home, the researcher will provide you with a paper version of the Transition to Home Survey.
    - The research team's goal is to have you complete the survey the day you leave the hospital.
    - This survey asks questions about your age; gender; marital status; educational background; number of emergency visits; reason for hospitalization; number of times you communicated with various members of the healthcare team; how ready you feel to go home; knowledge about problems to watch for after you go home; and how much help you expect to have/need at home.
    - Before you leave the hospital, the researcher will return to collect the survey. If you have not completed the survey, or you leave the hospital prior to seeing the researcher, you can return the survey via the locked box on the unit. A stamped envelope will also be provided to you in case you were unable to complete the survey prior to discharge so that you may mail it back.
    - In the survey, you are free to skip any questions that you would prefer not to answer.
  
  - **Post-Hospital Discharge Survey:**
    - The researcher will call you 30-days after you were discharged from the hospital to complete the post-discharge patient survey.
    - During this phone call, the researcher will ask you questions regarding your experiences related to your health after leaving the hospital. Examples of question
topics include: before leaving the hospital did you have a clear plan for your care; did the hospital staff take your preferences into consideration; when you left the hospital did you have all the information you needed to care for yourself; did you understand what warning signs to watch for; what was your level of confidence with managing your health; were you informed about your medications; how stressful was going home; did you have any difficulties after being discharged.

○ The researcher will attempt to contact you up to three times by phone, and may leave a voice message with contact information. If the researcher is unable to reach you by phone, then a survey will be mailed to you with a stamped return envelope. Please return the survey with in the week to the researcher.

○ For the survey and follow up phone call interview, you are free to skip any questions that you would prefer not to answer.

Additional Data Sources:

- As a part of this study, the researcher is asking permission to access your health information from your medical records.
  - The following information will be gathered from your medical records: length of stay (days in the hospital), severity of illness, number of comorbidities, time of hospital discharge, presence of intensive care stay, reason for hospitalization, quality of discharge instructions (i.e., presence of medication list, follow up appointments, who to call with problems, symptoms to watch out for, and contact information), and content of the discharge summary (presence and or description of your diagnosis, significant findings of hospital course, procedures performed, test results, functional status, cognitive status, physical findings, lab results, medications, and social support).

- The researcher will also talk to your providers (nurse, case manager, doctor, physical therapist (if appropriate) and cardiac rehab educator (if appropriate) about your health and care coordination during discharge.

WHAT ARE THE RISKS OF THIS STUDY?

You may experience one or more of the risks indicated below from being in this study. In addition to these, there may be other unknown risks, or risks that we did not anticipate, associated with being in this study.

There is a risk of emotional stress due to telling about personal health related information or experiences felt during or after the hospital discharge process. Your participation is completely voluntary, you can decide not to fill out the surveys at any time, and skip any questions that you choose not to answer. If you experience emotional stress, and would like to speak to someone, you can contact Mercy Iowa City’s Patient Representative Office at 319-688-7054.

WHAT ARE THE BENEFITS OF THIS STUDY?

We don’t know if you will benefit from being in this study.
However, we hope that, in the future, other people might benefit from this study because of your participation. We hope that this study will further our understanding of how the hospital healthcare team impacts the level of patient readiness to take care of themselves safely at home. The expected outcome of this pilot study is to provide a foundation to help develop evidence-based practices for the healthcare team to improve patient readiness for hospital discharge. My goal is to ultimately provide hospitals guidance for improving the transition to home for patients, and therefore improve the quality of patient care. Additionally, the de-identified results will be shared with the Mercy Hospital to help inform their discharge practices.

**WILL IT COST ME ANYTHING TO BE IN THIS STUDY?**

You will not have any costs for being in this research study.

**WILL I BE PAID FOR PARTICIPATING?**

You will be paid for being in this research study. You will receive $5 for completing the Transition to Home Survey, and $5 for completing the Post-Discharge Survey. To allow time for the surveys to be completed, your compensation will be mailed to you 6 weeks after your hospital discharge. You may also need to provide your address if a check will be mailed to you. You have the opportunity to receive a total of $10 in compensation for completing both surveys.

**WHO IS FUNDING THIS STUDY?**

Versant Center for the Advancement of Nursing (VCAN®) and the Midwestern Nursing Research Society is funding this research study. This means that the University of Iowa is receiving payments from the Versant Center for the Advancement of Nursing (VCAN®) and the Midwestern Nursing Research Society to support the activities that are required to conduct the study. No one on the research team will receive a direct payment or increase in salary from the Versant Center for the Advancement of Nursing (VCAN®) or the Midwestern Nursing Research Society for conducting this study.

**WHAT ABOUT CONFIDENTIALITY?**

We will keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people such as those indicated below may become aware of your participation in this study and may inspect and copy records pertaining to this research. Some of these records could contain information that personally identifies you.

- federal government regulatory agencies,
- auditing departments of the University of Iowa, and
- the University of Iowa Institutional Review Board (a committee that reviews and approves research studies)

Efforts will be taken to protect your rights to privacy by collecting the minimum information necessary to meet the aims of this study. To help protect your confidentiality, your responses will be kept...
confidential, including assignment of ID numbers and physical and electronic security measures. Patient surveys will only include your participant ID number. Your providers will be completing a survey about your discharge process. To inform providers that the survey is linked to you, your initial will appear on the first sheet of the survey. The first sheet of the survey will be destroyed upon being returned to the researcher. The remaining surveys will only include a participant ID number. The participant ID number will be linked to your name. The list linking your name and your study identification code will be stored in a separate location that is accessible only to the researchers. A locked box will be kept on the unit to safely collect surveys. Any hard copies that must be physically transported from the study site to a secure office or computer will be hand-carried by the researcher in a locked box. All hard copies will be maintained in a locked file drawer to which only the researcher has access. All computer files will be stored on password-protected devices and accessible only by the researcher. The data for this study will be stored electronically in the REDCap platform. The REDCap platform is managed by the Institute for Clinical and Translational Science at the University of Iowa. Only IRB approved research team members will have access to the REDCap data platform. Notably, if we write a report or article about this study or share the study data set with others, we will do so in such a way that you cannot be directly identified.

WILL MY HEALTH INFORMATION BE USED DURING THIS STUDY?

As a part of this study, the researcher is asking permission to access your health information from your medical records. The researcher will also talk to your providers (nurse, discharge coordinator, and physician) about your health and care coordination during discharge. To participate in this study will have you complete a Release of Information document to allow your medical information to be shared with the research team.

IS BEING IN THIS STUDY VOLUNTARY?

Taking part in this research study is completely voluntary. You may choose not to take part at all. If you decide to be in this study, you may stop participating at any time. If you decide not to be in this study, or if you stop participating at any time, you won’t be penalized or lose any benefits for which you otherwise qualify.

What if I Decide to Drop Out of the Study?

If you decide to leave the study early, we will ask you to notify the PI that you are withdrawing from the study by sending an email to Kirstin Manges at kirstin-manges@uiowa.edu or by calling at 231-838-3231.

Can Someone Else End my Participation in this Study?
Under certain circumstances, the researchers might decide to end your participation in this research study earlier than planned. This might happen because unexpected events may occur on the day of hospital discharge (i.e., not being discharged from the hospital or other participants withdrawing from the study). However, once you are enrolled in the study, you will be given the opportunity to complete both surveys, and be eligible for compensation.

WHAT IF I HAVE QUESTIONS?

We encourage you to ask questions. If you have any questions about the research study itself, please contact the PI Kirstin Manges (email: Kirstin-Manges@uiowa.edu; Phone: 231-838-3231) and/or the supervising faculty member Patricia Groves (email: patricia-groves@uiowa.edu). If you experience a research-related injury, please contact the PI Kirstin Manges (email: Kirstin-Manges@uiowa.edu; Phone: 231-838-3231) and/or the supervising faculty member Patricia Groves (email: patricia-groves@uiowa.edu).

If you have questions, concerns, or complaints about your rights as a research subject or about research related injury, please contact the Human Subjects Office, 105 Hardin Library for the Health Sciences, 600 Newton Rd, The University of Iowa, Iowa City, IA 52242-1098, (319) 353-6564, or e-mail irb@uiowa.edu. General information about being a research subject can be found by clicking “Info for Public” on the Human Subjects Office web site, http://hso.research.uiowa.edu/. To offer input about your experiences as a research subject or to speak to someone other than the research staff, call the Human Subjects Office at the number above.

This Informed Consent Document is not a contract. It is a written explanation of what will happen during the study if you decide to participate. You are not waiving any legal rights by signing this Informed Consent Document. Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subject’s Name (printed): ______________________________________

Do not sign this form if today’s date is on or after EXPIRATION DATE: 11/15/18.

________________________________________   ____________
(Signature of Subject)                        (Date)

Statement of Person Who Obtained Consent

I have discussed the above points with the subject or, where appropriate, with the subject’s legally
Appendix E4 Release of Information

| Clinical Information Services | 500 E. Market St. | Iowa City, Iowa 52245 | Phone: 319-339-3682 | Fax: 319-329-3785 |

**MERCY HOSPITAL, IOWA CITY, IOWA**

**AUTHORIZATION FOR RELEASE OF PROTECTED HEALTH INFORMATION**

#9-19 (9/13 revised)

**PATIENT IDENTIFICATION**

Name: 

Last: 

First: 

M.: 

Birth Date: ___________ Social Security #: ___________ Medical Record #: ___________

Address: 

Street: 

City: 

State: 

Zip: 

Telephone Number: 

Home: 

Other: 

**FROM PROVIDER**

(Who is to release the information?)

Name: 

Street Address: 

City, State, Zip: 

Phone #: 

Fax #: 

**TO RECIPIENT**

(Who is to receive the information?)

Name: Kiratin Manges

Street Address: 602 Manor Dr

City, State, Zip: Iowa City, IA 52246

Phone #: 231-038-3231

**TYPE OF INFORMATION BEING REQUESTED**

| For date(s) of service: ___________ / ___________ / ______ to ___________ / ___________ / ______ |
| --- | --- | --- | --- | --- |
| Discharge Summary | Operative Report | X-Ray Report | Image |
| History & Physical Report | Pathology Report | Consults | Abstract Summary |
| Emergency Room Report | Laboratory Report | | |
| Other: (Specify): | | | |

**SPECIFIC AUTHORIZATION FOR RELEASE OF INFORMATION FURTHER PROTECTED BY STATE OR FEDERAL LAW**

Initial any category NOT to be released:

- Acquired Immunologic syndrome (AIDS) or human immunodeficiency virus (HIV)
- Alcohol and drug abuse treatment
- Behavioral or mental health services

**PURPOSE FOR DISCLOSURE**

- Patient Care
- Insurance Claim
- Other: (Specify): (Fees Apply)
- Legal Review (Fees Apply)

**TIME LIMIT**

I understand that I may cancel (revoke) this authorization at any time by sending a written notice to Mercy’s Health Information (Medical Records) department and that my cancellation will take effect when the written notice is received and it will not apply to information that has already been released in response to this authorization. This authorization will automatically expire one year from the date of signature except as specified. (Specify expiration date, event, or condition.)

I understand that authorizing the disclosure of this health information is voluntary. I need not sign this form in order to receive treatment. I understand that I may inspect or copy the information to be used or disclosed. I understand that if the person or entity that receive the information is not a health care provider or health plan covered by federal privacy regulations, the information may be re-disclosed and no longer protected by federal privacy regulations unless otherwise prohibited from re-disclosure under other federal and/or state laws or regulations.

**SIGNATURE AND DATE**

Signature (Patient or Legal Representative): 

Date: 

Relationship, if not patient: 

Witness:

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APPENDIX F TOOLS

Appendix F1 Provider Demographic Questionnaire

This appendix includes the questionnaire that was provided to provider participants to collect their demographic information. The providers only received a paper version of this questionnaire one time, and this appendix presents the format used in the study.

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Discharge Teams’ Preliminary Survey

1. What is your staff position in the hospital? Select ONE answer that best describes your staff position.
   - ☐ Case Manager
   - ☐ Physical Therapist
   - ☐ Bedside Nurse
   - ☐ Cardiac Rehab Provider
   - ☐ Physician

2. What is your highest completed degree:
   - ☐ ADN
   - ☐ MD
   - ☐ BSN
   - ☐ MSN
   - ☐ BSW
   - ☐ MSW
   - ☐ DNP
   - ☐ DO
   - ☐ Other: ______________

3. What is your gender?
   - ☐ Male
   - ☐ Female
   - ☐ Other: ______________

4. What is your birthdate: ____ / ____ / ____

5. What inpatient unit(s) do you currently and most frequently work on? ______________

6. How many years have you worked in your current staff position (i.e., bedside nurse, case manager, physical therapist, cardiac rehab provider, or physician)? Year(s): __________

7. How many years have you worked at this hospital? Year(s): __________

8. How many years have you worked on your current unit(s)? Year(s): __________

9. Please give your work area/unit in this hospital (as identified in question 4) an overall grade on patient safety.
   - ☐ Excellent
   - ☐ Very Good
   - ☐ Acceptable
   - ☐ Poor
   - ☐ Failing

10. In general, what are major facilitators (things that make it easier) to discharge patients on your hospital unit/department?

11. In general, what are major barriers (things that make it harder) to discharge patients from your hospital unit/department?

12. Pending funding of a research grant, there may be an additional opportunity to participate in a short interview study about factors influencing care coordination during discharge. If you are interested in the opportunity to participate please provide the following information:
   - Name: ______________
   - Phone number: ______________
   - Email: ______________
Appendix F2. Patient Screening Form

This is the screening form used to determine if the patient was eligible to participate in the study. The screening form includes the Short Portable Mental Status Questionnaire (SPMSQ), which is a widely used 10-item scale used to distinguish cognitively impaired subjects from cognitively intact subjects (Pfeiffer, 1975).

SCREENING COLLECTION FORM

Reason for Admission: __________________________________________________________
Inpatient Unit Type: ___________________________________________________________

1. What condition was the patient admitted with/for?
   - [ ] Congestive Heart Failure
   - [ ] Acute Myocardial Infarction
   - [ ] Hip Replacement
   - [ ] Knee Replacement
   - [ ] Pneumonia
   - [ ] Chronic Obstructive Pulmonary Disease

2. What is the patient's age: __________

3. Is he/she older than 65 years old?
   - [ ] Yes
   - [ ] No

4. Where did the patient live prior to admission to the hospital?
   - [ ] Home
   - [ ] Assisted Living
   - [ ] Skilled Nursing Facility
   - [ ] Other: __________

5. Does the patient expect to be discharged directly home without home health services or hospice care?
   - [ ] Yes
   - [ ] No

6. Does the patient report being comfortable speaking English?
   - [ ] Yes
   - [ ] No

7. Score on the Short Portable Mental Status Questionnaire: __________
Screening Collection Form (Continued)

Short Portable Mental Status Questionnaire (SPMSQ)

Instructions: Ask questions 1 to 10 on this list and record all answers. All responses must be given without reference to calendar, newspaper, birth certificate or other prompt to the memory. Record the total numbers of errors based on the answers to the 10 questions.

<table>
<thead>
<tr>
<th>+</th>
<th>-</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td>What is the date today?</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>What day of the week is it?</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>What is the name of this place?</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>What is your telephone number?</td>
</tr>
<tr>
<td>4a.</td>
<td></td>
<td>What is your street address?</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>How old are you?</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>When were you born?</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Who is the president of the United States now?</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>Who was president just before him?</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>What was your mother's maiden name?</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>Subtract 3 from 20 and keep subtracting 3 from each now number, all the way down.</td>
</tr>
</tbody>
</table>

______Total Number of Errors
Appendix F3 Patient Transition to Home Survey

This appendix includes the questionnaire that was provided to patient participants on the day of hospital discharge. The Patient Transition to Home Survey includes the patient demographic questionnaire (sections 1 and 2), as well as Weiss and Paicentine’s (2006) Readiness for Hospital Discharge Scale (section 3). Patients received a paper version of the survey, and this appendix presents the format used in the study.

<table>
<thead>
<tr>
<th>Section 1. Demographic Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your birthdate: <em><strong>/</strong></em>/___</td>
</tr>
<tr>
<td>What is your gender?</td>
</tr>
<tr>
<td>□ Male  □ Female  □ Other:</td>
</tr>
<tr>
<td>What is your ethnic origin/race?</td>
</tr>
<tr>
<td>□ Asian  □ Black  □ Native American</td>
</tr>
<tr>
<td>□ Hispanic  □ White, Non-Hispanic</td>
</tr>
<tr>
<td>□ Other: ___________________________</td>
</tr>
<tr>
<td>What is your marital status?</td>
</tr>
<tr>
<td>□ Never Married  □ Married</td>
</tr>
<tr>
<td>□ Separated/Divorced  □ Widowed</td>
</tr>
<tr>
<td>Where do you live most of the year? {Check one box}</td>
</tr>
<tr>
<td>□ Your home, apartment or condo</td>
</tr>
<tr>
<td>□ Senior citizen apartment/condo</td>
</tr>
<tr>
<td>□ Home of a relative/friend</td>
</tr>
<tr>
<td>□ Retirement home</td>
</tr>
<tr>
<td>□ Nursing home</td>
</tr>
<tr>
<td>□ Other: ___________________________</td>
</tr>
<tr>
<td>How many people live with you? {Check one box}</td>
</tr>
<tr>
<td>□ I live alone</td>
</tr>
<tr>
<td>□ 1 person</td>
</tr>
<tr>
<td>□ 2 people</td>
</tr>
<tr>
<td>□ 3 people</td>
</tr>
<tr>
<td>□ 4 or more people</td>
</tr>
</tbody>
</table>
Demographic Questionnaire (Continued)

How much schooling have you had? (Years of formal schooling completed)
- 8 grades or less
- Some high school
- High school graduate or GED
- Some college or technical school
- College graduate (bachelor’s degree)
- Graduate degree

Which of the following best describes your current employment status?
(What one box)
- Working full-time, 35 hours or more a week
- Working part-time, less than 35 hours a week
- Unemployed or laid off and looking for work
- Unemployed and not looking for work
- Homemaker
- In school
- Retired
- Disabled, not able to work
- Something else? (Please specify): __________________________

How would you describe the insurance plan(s) you have had in the past 12 months?
- An individual plan – the member pays for the plan premium
- A group plan through an employer, union, etc. – the employer pays all the plan premium
- U.S. Governmental Health Plan (e.g., Military, CHAMPUS, VA)
- Medicaid
- Medicare
- I have not had an insurance plan in the past 12 months

How many emergency room visits have you had in the last 12 months?
- 0 Emergency room visits
- 1 Emergency room visits
- 2 Emergency room visits
- 3 Emergency room visits
- 4 Emergency room visits
- 5 or more emergency room visits
**Demographic Questionnaire (Continued)**

How many different hospital admissions have you had in the last 12 months?

- ☐ 1 Hospital admission (this hospital admission)
- ☐ 2 Hospital admissions, including this admission
- ☐ 3 Hospital admissions, including this admission
- ☐ 4 Hospital admissions, including this admission
- ☐ 5 or more hospital admissions, including this admission

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**Section 2. Current Hospital Stay**

Questions 12-16 are related to this hospital stay or admission

Please describe why you were admitted to the hospital?

________________________________________________________________________

________________________________________________________________________

How many days have you been in the hospital for this admission?

Days: __________

Was this hospital admission planned?

- ☐ Yes
- ☐ No

Did you experience any delays to being discharged from the hospital? If so, what were the causes of the delays?

- ☐ Yes
- ☐ No

Comments:

________________________________________________________________________

________________________________________________________________________

On the day you were discharged from the hospital, estimate the number of times you talked with the following people? Put an X if not available.

<table>
<thead>
<tr>
<th>Individuals</th>
<th>Number of times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedside Nurse</td>
<td></td>
</tr>
<tr>
<td>Case Manager</td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td></td>
</tr>
<tr>
<td>Physical Therapist</td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>
### Section 3. Patient Readiness for Hospital Discharge Survey

For questions 17-25, please circle the number that best describes how you feel. The answers are on a 10-point scale from 1 to 10. The words above the number indicate what 1 or 10 means.

<table>
<thead>
<tr>
<th>Question</th>
<th>Not ready</th>
<th>Totally ready</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. How physically <strong>ready</strong> are you to go home?</td>
<td>0 1 2 3 4 5 6 7</td>
<td>8 9 10</td>
</tr>
<tr>
<td>18. How would you describe your <strong>energy</strong> today?</td>
<td>Low energy</td>
<td>High energy</td>
</tr>
<tr>
<td>19. How much do you <strong>know about problems to watch for</strong> after you go home?</td>
<td>Know nothing at all</td>
<td>Know all</td>
</tr>
<tr>
<td>20. How much do you <strong>know about restrictions</strong> (what you are allowed and not allowed to do) after you go home?</td>
<td>Know nothing at all</td>
<td>Know all</td>
</tr>
<tr>
<td>21. How well will you be able to <strong>handle the demands</strong> of life at home?</td>
<td>Not at all</td>
<td>Extremely well</td>
</tr>
<tr>
<td>22. How well will you be able to <strong>perform your personal care</strong> (for example, hygiene, bathing, toileting, eating) at home?</td>
<td>Not at all</td>
<td>Extremely well</td>
</tr>
<tr>
<td>23. How much <strong>help</strong> will you have with your <strong>personal care</strong> after going home?</td>
<td>None</td>
<td>A great deal</td>
</tr>
<tr>
<td>24. How much <strong>help</strong> will you have with your <strong>medical care needs</strong> (treatments, medications) after going home?</td>
<td>None</td>
<td>A great deal</td>
</tr>
<tr>
<td>25. <strong>Overall</strong>, how ready do you feel to go home?</td>
<td>Not ready</td>
<td>Totally ready</td>
</tr>
</tbody>
</table>

Page 4
Appendix F4 Provider Transition to Home Survey

The Provider Demographic Questionnaire was completed once, while the Provider Transition to Home Survey was completed by each provider on the discharge team for each discharge event. The survey is presented as it was administered to providers.

Section 1. Patient Readiness Assessment
Questions 1-8: Use this section to assess readiness for discharge of your hospitalized patient. Complete this form on the day of discharge. Please circle your answer. Pick the number between 0 and 10 that best describes how you feel. For example, circling number 7 means you feel more like the description of number 10 than number 0 but not completely.

<table>
<thead>
<tr>
<th>Question</th>
<th>Score Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How physically ready is your patient to go home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Not ready Totally ready</td>
</tr>
<tr>
<td>2. How would you describe your patient’s energy today?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Low energy High energy</td>
</tr>
<tr>
<td>3. How much does your patient know about what problems to watch for after going home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Know nothing at all Know all</td>
</tr>
<tr>
<td>4. How much does your patient know about restrictions (what he/she is allowed and not allowed to do) after going home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Know nothing at all Know all</td>
</tr>
<tr>
<td>5. How well will your patient be able to handle the demands of life at home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Not at all Extremely well</td>
</tr>
<tr>
<td>6. How well will your patient be able to perform his/her personal care (for example, hygiene, bathing, toileting, eating) at home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 Not at all Extremely well</td>
</tr>
<tr>
<td>7. How much help will your patient have available if needed with his/her personal care after going home?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 None A great deal</td>
</tr>
<tr>
<td>8. How much help will your patient have available if needed with his/her medical care needs (treatments, medications)?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 None A great deal</td>
</tr>
</tbody>
</table>

Section 2. Discharge Team
Questions 9-22: The following questions are regarding your current and past experiences of working with this discharge team to prepare patients to leave the hospital. The discharge team includes the specific attending physician, bedside nurse, case manager, and other staff indicated on the cover page.

<table>
<thead>
<tr>
<th>Question</th>
<th>Score Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. How often do you work with this discharge team? Please check the appropriate box.</td>
<td>□ Never □ 1-2 times a month □ 1-2 a week □ Daily □ Other:______</td>
</tr>
<tr>
<td>10. All the other discharge team members understand my role in the team.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>11. The team members often contact me to offer help/advice when I need it.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>12. I often receive useful information from the team before I request it.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>13. I rarely receive useful advice unless I ask for it.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>14. All team members are aware of where to go for information when they need it.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>15. It is not always obvious where we should go for information when we need it.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
<tr>
<td>16. I am well aware of the other team member’s skills and abilities.</td>
<td>1 2 3 4 5 6 7 Strongly disagree Strongly agree</td>
</tr>
</tbody>
</table>

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Section 3. The Discharge Process

Questions 23-26: The following questions are about your experiences with discharging this specific patient from the hospital. The discharge team includes the specific attending physician, bedside nurse, case manager, and other staff indicated on the cover page.

<table>
<thead>
<tr>
<th>Question</th>
<th>Scale (1-7)</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. I would usually find it difficult to predict what other team members may do in particular situation.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. I can usually predict what my team members will do in a particular situation.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. The team adapts its behaviors to meet the needs of other team members.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. The team does not really utilize the capabilities and skills of its members.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. The team takes into consideration the capabilities of its members.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. I could explain all of the roles in the team and how they overlap.</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. How many days have you worked with this patient? Number of days: ________________

24. Overall, the team communicated appropriately while discharging this patient from the hospital. Number of days: ________________

25. I feel that we worked together as a team to prepare this patient for hospital discharge. Number of days: ________________

26. On the day the patient was discharged from the hospital, estimate the number of times that you communicated to the following people about discharging this patient. Consider all methods of communication: face-to-face, phone calls, paging etc. Please put an “X” for not available.

<table>
<thead>
<tr>
<th>Individual</th>
<th>Number of times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td></td>
</tr>
<tr>
<td>Family members</td>
<td></td>
</tr>
<tr>
<td>Bedside nurse</td>
<td></td>
</tr>
<tr>
<td>Case manager</td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td></td>
</tr>
<tr>
<td>Physical Therapist</td>
<td></td>
</tr>
<tr>
<td>Cardiac Rehab</td>
<td></td>
</tr>
</tbody>
</table>

27. Did you experience any barriers (things that made it harder) or facilitators (things that made it easier) to discharging this patient from the hospital? If so, please briefly describe below.

________________________________________________________________________________________________
________________________________________________________________________________________________
________________________________________________________________________________________________

Please return to Kirstin Manges (kirstin-manges@uiowa.edu) or to the locked box on the unit.
APPENDIX F5 Phone Script for Post-Discharge Patient Survey

This appendix includes the phone script for the post-discharge patient survey used to collect the Care Transitions Measure. Below is the script as used in the study.

Follow-up Phone Script for the Post-Discharge Patient Survey

This script is for the 30 day follow up survey with patients. The patient participants will be contacted three times. If I am unable to contact, a paper version of the survey will be mailed to the patient. Follow-up phone calls will have a three-day call range.

Introduction:

As the PI, I will re-introduce myself and become re-acquainted with the patient. I briefly will describe the purpose of the study and how they consented during discharge again.

During this discussion, I will restate that the participant does not have to answer any of the questions and how they can stop the interview at any time. I will make the participants aware that their decision to participate in the survey will not in any way affect your health care coverage. Also, I will remind them that their responses will not be directly shared with their doctors or nurses. I will inform them that the brief questionnaire should take no more than 10 minutes to answer.

Overview of introducing questions:

Then, if the participant agrees to take the survey, I will explain the response options for the various sections.

- First, I will ask two questions regarding if the patient returned to the hospital, and if so, what happened to make them come back to the hospital.
- Then, I will explain that I will be asking a series of 15 questions regarding their quality of transition home. For each question the response options will include: Strongly Agree, Agree, Disagree, or Strongly Disagree. Per directions of the scale, I will not initially introduce these options – “Don’t Know/Don’t Remember/Not Applicable”-- and will only offer them if it becomes clear the above four do not pertain to the participant.
- Then I will read “Part One” to the patient and record their responses.
- For the second section of the survey I will explain that the response options will be on a scale ranging from 0 to 10; with 0 being “not at all” and 10 being “a great deal”, “extremely well” or “completely.”
- Then I will read “Part Two” to the patient and record their responses.
- If the patient has any questions regarding their care, I will ask them to contact their healthcare provider.
- Inclosing I will thank them for their time.

The questions will be read directly off of the 30 day follow up survey.
APPENDIX G RESULTS

Figure G1. Distribution of Teamwork SMM score by inpatient unit type

Figure G2. Distribution of Teamwork SMM Convergence score by inpatient unit type.
Figure G3. Distribution of Taskwork SMM score by inpatient unit type.

Figure G4. Distribution of Taskwork SMM Convergence score by inpatient unit type.
Figure G5. Cumulative Function Plots for Quality of Transition Model. Cumulative function plots were created by plotting the cumulative sums of residuals by each continuous independent variable included in the Quality of Transition Baseline Model. The dark line is the fit for the observed cumulative residuals for each continuous variable included in the baseline model, which is then fitted together with the first 20 simulated data residuals from the null distribution. A Kolmogorov-type supremum test p-value greater than .05 indicates that the continuous variables residuals are normally distributed and that the functional forms are linear: a) Teamwork SMM ($p = .443$), b) patient age ($p = .778$), c) number of comorbidities ($p = .512$), d) team professional experience ($p = .170$), e) number of admission ($p = .271$), and f) Taskwork SMM ($p = .151$).
Figure G6. Standardized Pearson’s Residual by Predicted Betas for the Quality of Transition Final Model. The even distribution suggests good model fit and assumption of homoscedasticity are met. The individual predictors residuals vs. predicted values were also examined and appeared similarly appropriate.
Figure G7. Fit Diagnostics Plots for the Quality of Transition Final Model.
Figure G8. Dfeta Plots for the Baseline Model of Unplanned Utilization of Medical Services. The red (+) points are the participants who did utilize an unplanned medical service, while the blue circles points are those who did not.
Figure G9. Standardized Pearson Residual Plots of the Baseline Model of Unplanned Utilization of Medical Services. The red (+) points are the participants who did utilize an unplanned medical service, while the blue circles points are those who did not.