A Relational View of Hospital and Post-acute Staff Communication and Adherence to Evidence-based Transitional Care

by

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ABSTRACT

This descriptive research used social network analysis to explore the influence of relationships and communication among hospital nursing (RN, LPN, CNA) and discharge planning staff on adherence to evidence-based practices (EBP) for reducing preventable hospital readmissions. Although previous studies have shown that nurses are a valued source of research information for each other, there have been few studies concerning the role that staff relationships and communication play in adherence to evidence-based practice. The investigator developed the Relational Model of Communication and Adherence to EBP from diffusion of innovation theory, social network theories, relational coordination theory, and quality improvement literature.

The study sample consisted of 10 adult-medical surgical units, five home care agencies and six long-term care facilities. A total of 273 hospital nursing and discharge planning staff and 69 post-acute staff participated. Hospital staff completed a survey about communication patterns for patient care and patient discharge and about communication quality on the unit. Hospital and post-acute care staff completed surveys about relationship quality and demographic characteristics. Evidence-based practice adherence rates for risk assessment, medication reconciliation, and discharge summary were measured as documented in the electronic medical record.

Social network analysis was used to analyze the communication patterns for patient care communication at the unit. These findings were correlated with (1) aggregate responses for communication quality, (2) aggregate responses for relationship quality, and (3) EBP adherence. Statistically significant relationships were found between communication patterns, and communication quality and relationship quality. There were two significant relationships

between communication quality, and EBP adherence. Limitations in response rates and missing data prevented the analysis of all of the hypothesized relationships.

The findings from this study provide empirical support for the role of social networks and relationships among staff in adoption of, and adherence to, EBP. Social network theory and social network analysis, especially the concept of knowledge sharing, provide ways to understand and leverage the influence of peer relationships. Future studies are needed to better understand the contribution that relationships among staff (social networks) have in the adoption of and adherence to EBP among nursing staff. Further model development and multilevel studies are recommended.

DEDICATION

To my parents, Gerald Solomons, MD and Hope C. Solomons, EdD, the best role models for life and academic scholarship that a daughter could ask for.

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CHAPTER 1. INTRODUCTION

This research study explored the role of communication and relationships among nursing (LPN, RN, CNA) and discharge planning staff in enhancing adherence to evidence-based practice (EBP) for reducing preventable hospital readmissions. Inadequate communication among providers and gaps in adherence to EBP are two major contributors to sustained levels of preventable hospital readmissions. Chapter 1 provides the specific aims, background, and significance of this research. This chapter concludes with a brief discussion of the innovative conceptual and methodological approaches used in this study.

Overview of the Problem

The gap between the state of knowledge about reducing preventable readmissions and current outcomes places patients at significant risk of preventable adverse outcomes and places hospitals at significant risk for severe financial penalties. The National Quality Strategy spotlight has focused on the overuse of hospital services, particularly on preventable hospital readmissions. Preventable hospital readmissions are defined as an admission related to a previous admission which could have been avoided (Goldfield et al., 2008). Preventable readmission rates range from five to as much as 79% of initial hospital admissions due to differences among studies in how readmission was measured (van Walraven, Bennett, Jennings, Austin, & Forster, 2011). Preventable readmissions are associated with substantial adverse outcomes for patients including infections, falls, and medical errors (Department of Health and Human Services, 2010), and extremely high costs. In 2010, Medicare spending for inpatients as a result of readmission was $17.5 billion (Brennan, 2012). Readmission is often the result of poor communication between staff at various points of care (Forster et al., 2004) or gaps in the quality of hospital care (Goldfield et al., 2008; van Walraven et al., 2011).

Recognition of the potential for reducing hospital admissions and readmissions is not new. More than two decades ago, managed care organizations focused on medical diagnoses known as ambulatory care-sensitive conditions, such as pneumonia or heart failure that could be safely and effectively treated in the primary care setting at considerable cost savings (Zeng et al., 2006). Current efforts at health care reform, bolstered by years of research on interventions to reduce hospitalization, have driven new federal policies that now include incentives and penalties for readmission rates. In 2012, The Centers for Medicare and Medicaid Services (CMS, 2013) instituted penalties for 30-day readmissions for heart failure, pneumonia, and acute myocardial infarction, most of which are consistent with the previously identified ambulatory care sensitive conditions.

Unlike other areas of health care in which effective interventions have not yet been identified, a considerable amount is known about the characteristics of patients at risk for readmission (E. A. Coleman, Parry, Chalmers, & Min, 2006; Garrison, Mansukhani, & Bohn, 2013; Jencks, Williams, & Coleman, 2009; Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011) and clinical processes associated with readmissions such as breakdowns in communication within and across settings and lack of medication reconciliation (Garrison et al., 2013; Goldfield et al., 2008; Naylor et al., 2011; van Walraven et al., 2011). A number of transitional care and coaching programs (E. A. Coleman et al., 2006; Jacket al., 2008; Jencks et al., 2009; Naylor et al., 2004; Naylor, Kurtzman, & Pauly, 2009; Parry, Min, Chugh, Chalmers, & Coleman, 2009) have been evaluated in randomized control trials and were found to result in significant reductions in readmissions for populations with heart failure, diabetes, pneumonia, and chronic obstructive pulmonary disease. Yet, readmission rates do not appear to be dropping very quickly.

Between 2007 and 2010 there was only a 0.1% change in readmission rates. The average rate across the U.S. still hovers at almost 20% (Brennan, 2012).

Purpose

The purpose of this research was to explore the influence of communication and relationships among nursing (RN, LPN, CNA) and discharge planning staff on implementing evidence-based strategies for reducing preventable hospital readmissions. This study was one of the first to use social network theory and methods to understand adherence to evidence-based guidelines. In this research, social network theory served as the foundation for defining and relating important communication and relationship concepts antecedent to the use of evidence to reduce hospital readmissions. Previous research has shown that the greatest spread of evidence between nurses is due to informal unit-based communication patterns (who talks to whom) and the quality of the communication (Beke-Harrigan, Hess, & Weinland, 2008; Benner, Tanner, & Chesla, 1997; Cadmus et al., 2008; Estabrooks, Midodzi, Cummings, & Wallin, 2007; Estabrooks et al., 2005; McCaughan, Thompson, Cullum, Sheldon, & Thompson, 2002; Pravikoff, Tanner, & Pierce, 2005). These channels may be a powerful accelerant for improving hospital readmission rates.

Specific Aims

The specific aims of this study were:

- Aim 1: Explore the impact of communication patterns on communication quality.
- Aim 2: Explore the impact of communication patterns on relationship quality.
- Aim 3: Explore the impact of communication patterns on adherence to EBP.
- Aim 4: Explore the impact of communication quality on adherence to EBP.

- Aim 5: Explore the total effect of significant communication patterns and quality on EBP adherence.

Background and Significance

Hospital readmissions. Hospital readmissions are a multifactoral problem involving the patient, the hospital, and post-acute environments. Numerous medical and social factors place patients at risk of rehospitalization including high risk medication use, polypharmacy, prior hospitalizations, reduced social support, and low health literacy and education (Greenwald & Jack, 2007). Within the hospital, discharge planning may be carried out by multiple providers with varying experience and expertise (Finn et al., 2011). The current complex set of processes involved in transitioning a patient from hospital to post-acute settings often results in a fragmented system in which communication across settings becomes diluted (American Nurses Association, 2012; French et al., 2009; Naylor, 2012; Nosbusch, Weiss, & Bobay, 2011; Parry et al., 2009). Core processes to discharge planning such as transfer of information to primary care and post-acute providers and medication reconciliation may not be carried out consistently. While effective communication is foundational to seamless discharges (Golden, Tewary, Dang, & Roos, 2010; Kirsebom, Wadensten, & Hetstrom, 2012; Lamb, Tappen, Diaz, Herndon, & Ouslander, 2011; Minott, 2008), the reality is that discharge communication between providers across care settings is often absent, inaccurate, or delayed (Golden et al., 2010; Kirsebom et al., 2012; Lamb et al., 2011; Minott, 2008; National Transitions of Care Coalition, 2010; Naylor et al., 2011; Robinson & Street, 2004). Important details may be omitted from reports and summaries (Dawson, 2007; Golden et al., 2010; Nosbusch et al., 2011; Witherington, Pirzada, & Avery, 2008). Also, processes that rely on accurate and timely communication, including

medication reconciliation and patient education, may falter and contribute to readmissions (Lamb et al., 2011).

Transitional care programs. Most of the programs to reduce preventable readmissions focus on the vulnerable time of transfer between hospital and post-hospital setting. Known as transitional care, these programs incorporate a menu of strategies found to offset frequent causes of readmission including patient medication education and medication reconciliation between hospital and post-acute setting, patient education about effective self-care for chronic illness, making follow-up appointments, and sharing important information with post-acute providers (L. O. Hansen, Young, Hinami, Leung, & Williams, 2011b; Naylor et al., 2012; Rennke et al., 2013). Two of the best known models of transitional care, Naylor's Transitional Care Model (Naylor et al., 1994) and Coleman's Care Transitions Program (E. A. Coleman et al., 2004) rely on providing professional and lay coaches to help the transition from hospital to post-acute settings. Coaches provide seamless discharge planning, education, monitoring, and medication management support. Randomized control trials testing these models have shown significant reductions in readmission rates from 11.9% to 8.3% (E. A. Coleman et al., 2006) and from 61.2% to 47.5% (Naylor et al., 2004).

In contrast, other transitional care programs such as Project RED and Project BOOST focus on standardizing patient and provider communication, patient education, and work flow within the hospital setting (Jack et al., 2008; Jencks et al., 2009). In a randomized control trial of Project RED, Jack et al. (2009) reported a decrease in hospital utilization from 0.207 visits per patient per month to 0.149 visits per patient per month. A study of 11 hospitals that implemented one or more BOOST interventions reported a reduction in hospital readmissions by an average of 13.6% (L. O. Hansen, 2013).

To date, there has been extensive study, including randomized control trials, of the continuum models of transitional care and less evaluation of the hospital-based models like Project RED and Project BOOST. Most of the evaluations of the latter programs were conducted as qualitative research (Williams et al., 2014) or as part of rapid cycle quality improvement efforts rather than randomized control trials. Comparison across studies was difficult due to incomplete descriptions of context and professional preparation of individuals carrying out the interventions (Burke & Coleman, 2013; Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005; Greenhalgh et al., 2004; Naylor et al., 2011). Overall, studies of both types of models support sets of transitional care interventions. In their integrative review of both continuum and hospital-based transitional care programs, Hansen and colleagues (2011b) concluded that while no single component of these programs reliably reduced the rate of hospital readmission, there was support for selected sets or bundles of interventions. For example, a post-discharge phone call, present in both the Naylor and Coleman models, was not effective as the only intervention. Hansen and colleagues (2011b) hypothesized an interaction effect when more than one intervention was implemented and therefore recommended the use of bundles of transitional care interventions incorporating components found to reduce rehospitalization across transitional care models.

As a result of their evaluation of the expanding research and experiences of various transitional care models, most hospitals use elements from a number of models to reduce preventable hospital readmissions. Evidence-based interventions that standardize workflow, patient and provider communication, and documentation may be more appealing since competing priorities and financial restrictions impede the type and level of relationship necessary for the level of patient engagement found in the Transitional Care and Care Transition models (Burke & Coleman, 2013; Naylor et al., 2011). Common interventions across programs included

follow-up phone calls, medication reconciliation, timely discharge summary to the next point of care, and a follow-up appointment.

Evidence-based practice. Translating research into practice has been the focus of study for more than 30 years (Squires, Hutchinson et al., 2011). It is commonly reported that it takes as much as 17 years to move evidence-based findings to the bedside (Morris, Wooding, & Grant, 2011). EBP adoption among nurses has been examined from both individual and organizational perspectives (Eccles et al., 2005; Estabrooks, 2007). At the individual level, studies of EBP adoption among nurses focused on the individual nurse and his/her abilities to change practice (Estabrooks, 2007; Squires et al., 2011). In these studies the frequency with which nurses needed information to provide patient care and the methods for accessing this information was examined. One often cited national study of nurses' readiness for EBP, for example, reported that 61% of nurses require additional practice information one or more times per week and that 67% of nurses use colleagues or the internet to obtain this information (Pravikoff et al., 2005). In emergencies, information from other nurses was more trusted than information from research (Estabrooks et al., 2005). Furthermore, individual nurses reported numerous barriers to EBP adoption including (a) lack of value for research and practice; (b) lack of skill to obtain, interpret, and critique research; (c) lack of time (Beke-Harrigan et al., 2008; C. E. Brown, Wickline, Ecoff, & Glaser, 2009; Fink, Thompson, & Bonnes, 2005; Karkos & Peters, 2006; Koehn & Lehman, 2008; Pravikoff et al., 2005); and (d) exhaustion (Estabrooks et al., 2005). Studies of individual factors related to nurses' use of evidence have yielded numerous insights into need and barriers, but have not led to appreciable change in rates of use. Additional research focused on organizational factors, including culture, to explain EBP adoption and adherence (Kitson et al., 2008; Logan, Harrison, Graham, Dunn, & Bissonnette, 1999; Rycroft-Malone et al., 2004).

The organizational perspective of EBP adoption focused on aspects of organizational culture and leadership to support EBP. In these studies nurses often reported that peers and supervisors discouraged changes in process. Nurses believed they lacked the authority to change practice (Atkinson, Turkel, & Cashy, 2008; Karkos & Peters, 2006; McCaughan et al., 2002; Schoonover, 2009). The Promoting Action on Research Implementation in Health Services (PARIHS) framework recognized the importance of a facilitator, often a nurse educator or clinical specialist, to bridge the divide between research and practice (Harvey et al., 2002; Milner, Estabrooks, & Humphrey, 2005). Research days, grand rounds, and the presence of nurses on hospital committees helped spread the importance of EBP through the organization (Beke-Harrigan et al., 2008; Burns, Dudjak, & Greenhouse, 2009; Fink et al., 2005).

Today, nurses' adherence to EBP is still inconsistent (Kitson, 2007; Squires, Hutchinson et al., 2011). Studies by Pravikoff et al. (2005), Benner, Tanner, and Chesla (2000), and H. E. Hansen, Biros, Delaney, and Schug (1999) suggest that communication and relationships among staff may play a key role in transfer and use of evidence in clinical practice. Benner et al. (2000) and Estabrooks et al. (2005) found that nurses preferred to obtain information through social means over literature reviews, while peer relationships provided informal means to ask questions and learn from colleagues (Ko, 2011). Several studies reported that colleagues may be more influential than supervisors for continued adherence to EBP (Ko, 2011; Rangachari, 2008). Other studies by Manojlovich, Antonakos, and Ronis (2009) and Shortell et al. (1992) have demonstrated the importance of staff communication on patient outcomes. These findings about the contributions of communication and relationships have not been explored related to the use of nurses' use of evidence in practice.

Summary

In this study, social network theory provided a framework for examining the impact of communication and relationships among nursing (RN, LPN, and CNA) and discharge planning staff on the use of evidence to reduce hospital readmissions. This theoretical framework provided a multi-level canvas from which to explore EBP adoption and adherence using both individual and group perspectives which may be leveraged to inform EBP dissemination and adherence. Work by Shortell, Rousseau, Gilles, Devers, and Simons (1991) and Gittell (2002) were used to amplify the elements of communication and relationships within the social network umbrella. This research builds on and extends earlier work by Rogers (1995) and others on diffusion of information and innovations. The conceptual framework for this study will be explicated in Chapter 2.

Findings from this study focused on the role of communication and relationships among staff to inform the introduction, spread, and adherence to new evidence-based initiatives. The results would contribute to new knowledge about how evidence-based information spreads among nursing and discharge planning staff and is applied in practice. Examination of new components of information exchange, including communication and relationships, can contribute to new strategies to improve the effectiveness and efficiency of translating evidence-based interventions into clinical practice.

This research explored EBP diffusion and sustainability through the dual perspectives of relationships and communication. It used previous EBP findings regarding nurses' use of peers to obtain clinical information and support to launch new thinking and interventions to improve application of EBP in clinical practice.

CHAPTER 2. REVIEW OF THE LITERATURE AND CONCEPTUAL FRAMEWORK

The goal of this exploratory research was to describe the impact of communication patterns, communication quality, and relationship quality on the adoption of and adherence to evidence-based transitional care activities and hospital readmission rates through the lens of social network theory and analysis. The theoretical model for this study was derived from a synthesis of Rogers' (1995) diffusion of innovations theory, social network theories, relational coordination theory (Gittell, 2002), and literature from nursing, quality improvement, and healthcare utilization.

This chapter begins with a discussion of the theories that provide the conceptual underpinning for the model guiding the study. An explanation of the model constructs and concepts follows. The chapter concludes with a discussion of the hypothesized relationships and relevant literature in support of the model.

Theoretical Foundation

This section describes the underlying theories used in the development of the conceptual model: (a) diffusion of innovations theory (Rogers, 1995); (b) social network theory, including the strength of weak ties (Granovetter, 1973) and centrality (Freeman, 1978); and (c) relational coordination theory (Gittell, 2002). Together, these theories explain the role of communication and relationships in the adoption of EBP. An overview of each theory is provided including core concepts, relationships between theories, and highlights of research support.

Diffusion of innovations theory. Developed by Everett Rogers (1995), diffusion of innovations theory seeks to explain the process and rate of adoption of an innovation among individuals. This theory provided an overarching framework to explore the influence of

communication patterns on communication quality among hospital-based nursing (RN, LPN, CAN) and discharge planning staff, working relationships with post-acute settings, and adherence to evidence-based transitional care tasks to reduce hospital readmissions. Key constructs from Rogers' (1995) theory include innovation, adoption, and diffusion, and require explication. An innovation, according to Rogers, is something that was considered new to the recipient, an individual, or a group. Adoption is the acceptance of the innovation into use by the recipient. Diffusion is the temporal process by which the innovation is adopted by other members within the social system through communication channels (Rogers, 1995). That is to say, diffusion describes the spread of innovation adoption throughout the social system. Diffusion of innovations theory has been used frequently to explore how new practices are adopted within a health care setting. Greenhalgh and colleagues (2004), in their systematic review of applications of diffusion of innovations theory in health care, identified numerous innovations including (a) electronic database searching (Marshall, 1990); (b) clinical guidelines (Grilli & Lomas, 1994); and (c) health-related technologies (A. D. Meyer & Goes, 1988) that have been adopted in a process consistent with Rogers' (1995) theory.

Key concepts of interest within diffusion of innovations theory include social system, communication channels, boundary spanners, and opinion leaders. A social system is defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (Rogers, 1995, p. 23). Communication channels refer to the "interpersonal networks linking a system's members, determining who interacts with whom and under what circumstances" (Rogers, 1995, p. 24). Boundary spanners refer to members of the social system who have relationships with individuals in other social systems. These individuals are often positioned on the periphery of the social system, which allows more timely access to new

information. Due to the timely access to new information, boundary spanners are more likely to introduce innovation into the social system. Opinion leaders are trusted members of the social system who promote and spread the innovation through their relationships with others in the social system. Dopson, FitzGerald, Ferlie, Gabbay, and Locock (2002) reported a distinction between opinion leaders who came from outside the social system (referred to as an expert opinion leader) versus peer opinion leaders (referred to as an informal opinion leader). For example, academic detailing, described as face-to-face educational outreach, or a clinical nurse educator can be considered formal opinion leaders, whereas the nurse on the unit who is consulted for wound care is considered an informal opinion leader.

While opinion leaders can aid in the diffusion of adoption, characteristics of the innovation and its introduction into the social system also play a role. An innovation is more likely to be adopted if it is aligned with the beliefs and values of the social system. For example, EBP is more likely to be adopted if it is congruent with current practice on a hospital unit (Dobbins, Ciliska, Cockerill, Barnsley, & DiCenso, 2002). Other factors leading to adoption and diffusion include the ability to try out the innovation and the social system's capacity and available resources are also considered (Capezuti, Taylor, Brown, Strothers, & Ouslander, 2007; Dobbins et al., 2002; Ho et al., 2004; Leeman, Baernholdt, & Sandelowski, 2007; Milner et al., 2005).

A classic illustration of diffusion of innovations in a health care setting is the study by Coleman, Katz, and Menzel (1957) regarding physician prescribing practices for a new drug (tetracycline). The authors explored which of the physicians' interpersonal social networks were most likely to influence prescribing behavior over the period of the new product introduction. The influences of advisor, discussion, and friendship networks were measured beginning two

months after the drug was available. Comparisons of group influence were analyzed using an index of simultaneity ranging from 0 to 1, which was calculated from the date the physician learned of the drug from a peer. Professional network (advisors and discussions) was more influential at the outset, scoring between .60 and .75 out of 1 on the index, and decreased in influence over the course of the study. The friendship network was more influential later, with a peak index value of .50 out of 1, five months after the drug's release date. J. Coleman et al. (1957) hypothesized that the physicians who adopted the drug earlier were more engaged with their professional networks compared to the later adopting physicians. Their findings supported the role of communication and relationship in the diffusion of new practice.

Diffusion of innovations theory provides an overarching framework to explore how relationship and communication contribute to the spread of innovation within a collection of individuals. The concepts within the theory (social system, boundary spanner, opinion leader, and communication channels) are useful to understand how an innovation spreads, or diffuses, through a group of individuals. The innovation for this study was the adherence to evidence-based transitional care tasks. Definitions and understandings of these concepts are further enhanced within social network theory and relational coordination theory. Social network theories focus on relationships between and among individuals. These theories have been used to explain behaviors such as needle sharing and advice seeking. Furthermore, relational coordination theory focuses on the interaction between relationship and communication among independent groups for a common outcome.

Social network theory. Social network theory, the study of relationships among a set of individual, groups, and organizations, has roots in sociology (Burt, Granovetter, Freeman, Borgatti), anthropology (Kapferer, Nadel, Mitchell), and Gestalt psychology (Lewin, Moreno,

Heider). Historically, social network theory has been used to study individual and organizational relationship behaviors in business and technology. Krackhardt's (1993) study illustrates the influence of informal networks within the organization to get work done. Tsai (2000) used social network theory and analysis to illustrate how a unit's position within an organization influenced its access to information. Social network theory has been used in public health to understand disease spread (Christakis & Fowler, 2007) and adolescent smoking (Huang et al., 2014). Within the last two decades, social network theory has also been used in clinical environments to explain communication patterns in the emergency department (Creswick, Westbrook, & Braithwaite, 2009; Patterson et al., 2013), advice seeking (Armstrong & Klass, 2013; Hiscott & Connop, 1989; van Beek et al., 2011) and patient care communication among physicians (Bridewell & Das, 2011; Landon et al., 2012; Wensing, van Lieshout, Koetsenruiter, & Reeves, 2010).

Key concepts within social network theory include nodes, ties, tie strength, and centrality. Social networks are comprised of nodes (which represent individuals, groups, and larger entities) and ties (which represent the relationship of interest between two nodes). Social networks are bounded or defined by one or more criteria such as geography, income, or even disease. Within these social networks there can be smaller social networks bounded by discipline, gender, or shift, for instance.

Tie strength. Tie strength, strong or weak, describes the relationship between nodes, in the same way one differentiates between a close friend and an acquaintance. In the strength of weak ties theory, Granovetter (1973) defines tie strength as "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (p. 1361). Thus, between nodes when there is more time, emotional intensity, intimacy, and reciprocity (e.g., advice seeking), the stronger the tie. Nodes

connected by strong ties are more homogeneous; that is, they may have similar interests, training, education, and/or tenure in the organization. Two nurses who have worked together as part of a team on the same unit for the last 15 years are likely to be connected through a strong tie. In contrast, nodes connected by weak ties have less in common with each other; perhaps they sit on the same committee that meets quarterly, but otherwise do not have a reason to interact with each other.

Tie strength influences the type and success of the information exchange (M. T. Hansen, 1999; Szulanski, 1996). Nodes with strong ties develop a common set of experiences and language, ideal for exchanging tacit knowledge; that is, informal knowledge known only to a select group (M. T. Hansen, 1999; Reagans & McEvily, 2003). Weak ties have fewer shared experiences, lack common language (Burt, 2001, 2007; Granovetter, 1973), and are less familiar with each other due to the infrequency of interaction (Granovetter, 1973). Thus, complex and tacit knowledge, such as patient status, is more difficult to exchange between weak ties such as between acute and post-acute staff in different care settings.

Centrality. Centrality describes a node's position within the social network in comparison to other nodes. There are three separate measures of centrality: (a) the number of ties (relationships) the node has to other nodes (degree centrality), (b) the node's position in reference to other nodes such as the intermediate node between two other nodes (betweenness centrality), and (c) the distance of the node to other nodes in the social network (closeness centrality) (Freeman, 1978). In this study, only degree centrality was measured because the aggregate group value can be used to describe the social network structure. Also, this measure remained accurate with lower response rates.

In-degree and out-degree centrality describe the number of ties going into and coming out of the node. The unit-based nurse educator can be used to illustrate this concept. Staff nurses consult with the unit-based educator about practice (incoming ties to the unit-based educator). In turn, the unit-based educator turns to other nurse educators and experts with questions (outgoing ties from the unit-based educator). Nodes with high degree centrality are likely to be considered opinion leaders within the social network.

Degree centrality can also be applied to the collection of nodes and ties which is the whole social network. Centrality at the group level is referred to as centralization. Degree centralization, the aggregated degree centrality values for all of the nodes in the social network, is an indicator of how the social network is structured. When in-degree centralization is high, a few nodes have a proportionally larger number of incoming ties (Hanneman & Riddle, 2005), suggesting a hierarchical, or centralized, structure. When in-degree centralization is low, the proportion of incoming ties is relatively equal among the nodes in the social network, suggesting a decentralized or distributed structure.

Social network theory and analysis has been used previously in healthcare studies. It has been used to explore: overall information flow within a department (Creswick et al., 2009; Patterson et al., 2013), advice seeking communication among clinicians (Armstrong & Klass, 2013; Creswick & Westbrook, 2010; Hiscott & Connop, 1989; van Beek et al., 2011), and patient care communication among physicians (Bridewell & Das, 2011; Landon et al., 2012; Wensing et al., 2010).

Social network studies of communication flow among emergency department staff reported more frequent communication among social networks comprised of staff from the same discipline (intradisciplinary communication) compared to communication between social

networks comprised of staff from another discipline (interdisciplinary communication) (Creswick et al., 2009; Patterson et al., 2013). Specific nodes or individuals within each social network served as boundary spanners to communicate with designated nodes in other social networks (e.g., nurse to physician, physician to pharmacist and so forth), giving credence to findings by J. S. Brown and Duguid (2001), M. T. Hansen (1999), Szulanski (1996), and Gittell and Weiss (2004) that information travels more quickly within members of the same group than information travelling between groups.

Social network studies of advice seeking in clinical settings found that these social networks were smaller than the social networks describing friendship relationships (Armstrong & Klass, 2013; Creswick & Westbrook, 2010; Hiscott & Connop, 1989; van Beek et al., 2011). In two studies the advice seeking relationship was only in one direction, from novice to expert (Armstrong & Klass, 2013; Hiscott & Connop, 1989). Experts were co-workers on the same unit (Hiscott & Connop, 1989) or in another location (Armstrong & Klass, 2013), which may indicate something about unit culture.

Social network theory is useful to explain the influence of relationships between and among members of the social network regarding behaviors and communication. Social network theory concepts permit the examination of interconnectivity among nodes, the social network structure, which can be used to understand how quickly information travels through the social network. Yet, these theories by Granovetter, Freeman, and Hanson could not be used to fully explain communication quality and task interdependence. While it was possible to map the communication patterns using social network concepts and to know the strength of the tie, there is no way to determine whether the communication was successfully received and interpreted by

the recipient. Relational coordination theory addresses this gap as it examines both relationship and the quality of the communication.

Relational coordination theory. Relational coordination theory describes how relationship and communication between independent parties in uncertain environments influence a shared outcome. Gittell and colleagues (2000) first developed and applied relational coordination theory to the airline industry and subsequently applied the theory to health care where team members of different disciplines provide care to patients. Relational coordination theory had been used to explore how care teams work together to influence patient outcomes (Gittell, 2002; Gittell, Weinbert, Pfefferle, & Bishop, 2008; Gittell & Weiss, 2004; Havens, Vasey, Gittell, & Lin, 2010).

The theory is comprised of two constructs, relationship and communication, referred to as dimensions by Gittell (2002). The relationship construct is comprised of three concepts: (a) shared goals, (b) shared knowledge, and (c) mutual respect. These relationship concepts (taken from social network theory) are measures of organizational social capital. Social capital is the acquisition of resources (economic, national, and political) (Cené et al., 2011) obtained through the social network (Stanton-Salazar, 2011). Put simply, social capital is the act of leveraging one's relationships to obtain information, goods, or services. In some circles social capital is how work gets done (Prusak & Cohen, 2001). The communication construct is comprised of four concepts: (a) frequency, (b) timeliness, (c) accuracy, and (d) problem solving. These concepts are also included within the quality improvement literature (Shortell et al., 1991).

According to relational coordination theory, the relationship (shared goals, shared knowledge, and mutual respect) between independent parties influences their communication (frequency, timeliness, accuracy, and problem solving) in the early stages of engagement. As the

collaborative engagement matures, communication influences the relationship, thereby moving from a one-way influence to reciprocal influences.

Relational coordination had been shown to influence patient outcomes (Gittell et al., 2000) and nurses' perceptions of nursing quality of care, patient complaints, and patient safety including medication error, falls, and hospital acquired infection (Havens et al., 2010). A study of surgical patients across nine hospitals conducted by Gittell et al. (2000) found that relational coordination among patient care teams was significantly associated with patients' quality of care (β =1 .068, $p < .001$) and a decrease in post-operative pain ($\beta = 10.915$, $p = .041$). Length of stay also decreased, by 53.77% ($p < .001$). Patient outcomes, including decreased pain and shorter hospital stays, improved when relational coordination on the care team was high.

In another study, Havens and colleagues (2010) used relational coordination theory as part of a research-based framework with the goal to improve care coordination by addressing communication and clinicians' relationships with each other. As hypothesized by the authors, relational coordination was highest among nurses on the same unit, compared to relational coordination between units. Peri-operative units had the highest relational coordination between units ($\overline{x} = 3.26$, SD = 0.69) compared to nurses in other units (emergency, intensive care, medical-surgical, maternity, and surgical). Relational coordination scores were correlated with patient care quality, medication error, and falls with injury values. The authors reported a strong relationship between relational coordination and patient care quality ($r (746) = 0.49$, $p < .01$) and weaker, but still significant relationships in the negative direction for medication error ($r (733) = -.014$, $p < .01$) and falls with injury ($r (736) = -0.08$, $p < .05$). These studies illustrate the role of relationship and communication among team members to keep patients safe, specifically regarding medication error and falls with injury, and to improve patient outcomes.

In conclusion, the theoretical framework for this study drew from theories that ground the implementation of new practice within the communication patterns and relationships of participants. Rogers' (1995) concepts of social system, communication channels, and roles had been amplified using social network theories and relational coordination theory (see Table 1).

Table 1

Theoretical Framework Crosswalk

Diffusion of Innovation Theory: Rogers (1995)	Social Network Theories: Freeman (1978); Granovetter (1973)	Relational Coordination Theory: Gittell (2002)
Social system	Social network	
Communication channels	Tie (strength)	Relationship Shared knowledge Shared goals Mutual respect Communication Openness: Shortell et al. (1991) Accuracy
	Average path length (APL) Density Diameter	Timeliness
Roles Boundary spanner Opinion leader	Core-periphery In-degree centralization	

Rogers' (1995) social system is analogous to the social network in Granovetter and Freeman's work. The broad conceptualization of social system is re-envisioned as a collection of nodes and ties bounded by one or more criteria. Valente (1995) further linked social system and

social networks when he defined a social network as “a pattern of friendship, advice, communication or support which exists in a social system” (p. 31).

While Rogers focused on communication channels in his theory of diffusion of innovations, he implicitly incorporated both communication and relationships in his conceptualization of these channels. Individuals holding roles like boundary spanners and opinion leaders had specific relationships with others in the social system that allowed them to initiate and spread innovations. Social network theories also implicitly integrated communication and relationships in both concepts and measures. Gittell’s (2002) theory of relational coordination distinguished between communication and relationships and thus enabled examination of each dimension separately to the uptake of innovation and best practices.

Conceptual Model

The conceptual model for this study, A Relational View of Communication and Adherence to Evidence-based Practice, is a four-stage model consisting of five constructs: (a) communication patterns, (b) communication quality, (c) relationship quality, (d) adherence to EBP and (e) preventable hospital admissions. Each construct, its underlying concepts, and relationship to other constructs in the model are defined in Figure 1.

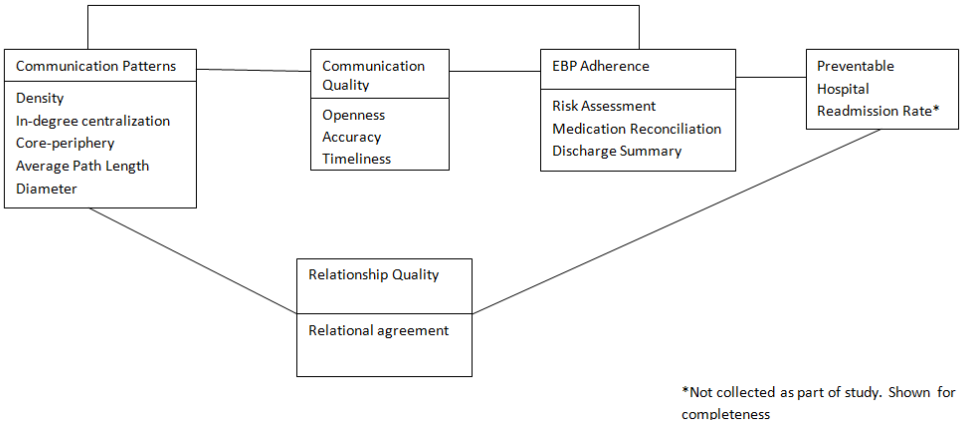

Figure 1. A Relational View of Communication and Adherence to Evidence-based Practice

Communication patterns (Stage 1). Conceptualization of the Stage 1 construct, communication patterns, was drawn from diffusion of innovations theory and social network theories. Communication patterns represented the flow of information about patient care and discharge between and among individuals within the social network. The communication patterns construct was comprised of five concepts: (a) density, (b) in-degree centralization, (c) core-periphery, (d) average path length (APL), and (e) diameter, described in the subsequent paragraphs. In social network theories, concepts and measurement often are intertwined. Thus, the following concept definitions explain the meaning of each concept in social network theory and an orientation to its measurement which assists in understanding the concept in social network terms.

Density. Density describes the interconnected web of ties between and among nodes within the social network. Social networks comprised only of strong ties are smaller and more homogeneous (Kraatz, 1998), and these nodes probably obtain information from the same sources, a concept referred to as knowledge redundancy (Burt, 2001, 2007; Granovetter, 1973).

Knowledge redundancy can be thought of as a limitation because when there is too much redundancy, the nodes' ability to obtain and utilize new information may be limited, leading to restrictive and/or censored communication within the social network (Mascia & Cicchetti, 2011). In comparison, a social network comprised of strong and weak ties is more heterogeneous and has varied sources of information.

In-degree centralization. In-degree centralization describes the distribution of incoming ties (ties into a node) among all of the nodes in the social network, a reflection of the organization's social network structure (Freeman, 1978). When the majority of the incoming ties are distributed to only a few nodes, the social network is considered to have a hierarchical structure because all of the relationship activity of the tie (for example, communication or advice seeking) is directed by those few nodes. When the incoming ties are distributed evenly among all of the nodes, the social network is considered to have a decentralized structure (Valente, 2010). West, Barron, Dowsett, and Newton (1999) reported that nurses are more likely to be organized hierarchically whereas physicians' networks tend to be decentralized.

Core-periphery. Core-periphery describes the distribution of node positions within the social network structure. Nodes in the center, or core, have greater access to both internal and external information and tend to be more powerful and influential than those on the edge, or periphery, of the social network (Valente, 2010). Nodes positioned on the periphery are more likely to have ties to nodes in other social networks, and consequently have greater access to external information (Burt, 1992, 2001, 2007; Gargiulo & Benassi, 2000). Referred to as boundary spanners (Rogers, 1995) or change agents (Greenhalgh et al., 2004; Schreiber & Carley, 2008), nodes on the periphery facilitate sharing or brokering new information between groups (J. S. Brown & Duguid, 2001; Hofmeyer & Marck, 2008) through activities and

relationship that cross locations (Heng, McGeorge, & Loosemore, 2005), departments (R. M. Meyer et al., 2011), and disciplines (Creswick et al., 2009; Patterson et al., 2013).

Average path length and diameter. Average path length and diameter describe the distance, measured as the number of ties between nodes in the social network. Average Path Length is an average of the shortest distance between any two nodes while diameter is a measure of the furthest distance between two nodes in the social network (Borgatti, Everett, & Johnson, 2013). These measures, in combination with centrality measures, are an indication of how quickly communication travels within the social network. Social networks with high density have a smaller value for APL and diameter than social networks with low density because of the greater interconnectedness among nodes in a social network with high density.

In this study, communication patterns were hypothesized to be directly related to communication quality, relationship quality, and EBP adherence. Support for the hypothesis was described within the aforementioned constructs. An indirect relationship to preventable hospital readmission rates was also hypothesized. Communication patterns describe node position and the interconnectivity among nodes within the social network, but do not address the quality of the communication between nodes.

Communication quality (Stage 2). Conceptualization for the Stage 2 construct, communication quality, was drawn from Gittell's (2002) theory on relational coordination and quality improvement literature (Shortell et al., 1991, 1992). Communication quality describes staff's perceptions of sending and receiving communication and was comprised of three concepts: (a) openness, (b) accuracy, and (c) timeliness. Openness is defined as being able to say what you think without fear of repercussions or misunderstanding (Shortell et al., 1991). Accuracy is defined as the degree to which nurses believe in the consistent veracity of the

information conveyed to them by other nurses (Shortell et al., 1991). Timeliness is defined as the degree to which patient information was relayed promptly to the people who needed to be informed (Shortell et al., 1991).

In this model, a direct relationship was hypothesized from communication patterns to communication quality. A direct relationship was also hypothesized between communication quality and EBP adherence (Stage 3), which will be described under EBP adherence.

Communication patterns and communication quality. The theoretical model for the study hypothesized a link between communication patterns and communication quality. Theoretical support for this relationship is derived from relational coordination theory (Gittell, 2002). Communication patterns represent the relationship dimension and communication quality represents the communication dimension defined in Gittell's (2002) theory.

Although there was no direct link between the social network literature and communication quality, a strong relationship can be inferred from the research utilization literature. The following discussion is organized by the concepts under communication quality.

Openness. Openness is defined as being able to say what you think without fear of repercussions or misunderstanding (Shortell et al., 1991). Feeling emotionally safe to speak openly among others implied a level of trust inherent among strong ties. Nurses shared a common background, training, and had spent significant time together. They sought support and advice from other nurses (Estabrooks et al., 2005; Pravikoff et al., 2005; Profetto-McGrath, Smith, Hugo, Taylor, & El-Hajj, 2007) in their support network. Nurses' support networks were small and may have been part of the larger friendship network (Armstrong & Klass, 2013; Hiscott & Connop, 1989).

Another way of thinking about openness is the acceptance of others' interpretations and practices. Social networks with permeable boundaries are more likely to be able to accept and absorb new information (French et al., 2009) due to boundary spanning ties and differing sources of information (Burt, 2007). Activities such as research grand rounds and research days (Fink et al., 2005) brought new information into the social network through boundary spanning peers in other parts of the organization. In contrast, social networks with impermeable boundaries may have high in-degree centralization where all communication flows through a single person, there are few to no boundary spanning nodes, and ties are strong and highly interconnected. In this scenario, the unit is focused inward and was not attending to external influence (Emery & Trist, 1965). Strong, dense ties and knowledge redundancy indicate a presence of "group think" (Mascia & Cicchetti, 2011, p. 803) in which nurses may not have felt they have the authority to introduce new practice (Atkinson et al., 2008; Fink et al., 2005; Karkos & Peters, 2006; McCaughan et al., 2002; Schoonover, 2009) and there be a risk of behavioral sanctions for speaking openly (K. T. Harris, Treanor, & Salisbury, 2006; Lyndon, 2008). In these circumstances, nurses may not question improper practice or may use workarounds to avoid behavioral sanctions, but these behaviors could lead to distrust and lack of collaboration among the care team (Lyndon, 2008; L. A. Miller, 2003), which could lead to poor communication within the care team and with others.

Accuracy. Accuracy is in the eyes of the information recipient (Borgatti & Cross, 2003). It is defined as the degree to which nurses believe in the consistent veracity of the information conveyed to them by other nurses (Shortell et al., 1991).

Patient information may be discipline specific and can become exponentially complex depending upon patient acuity, which can influence perceptions of accuracy (Gittell & Weiss,

2004). Viewed through the lens of social network theory and analysis, successful exchange of such complex and probably tacit information requires strong ties (Granovetter, 1973; M. T. Hansen, 1999). Other nurses are considered trusted sources of information (Estabrooks et al., 2005) since they share common work experience and training. For some nurses, other nurses are their only source of information for patient care questions (Pravikoff et al., 2005). Furthermore, nurses consult with each other due to lack of time and lack of ability to review the literature (Solomons & Spross, 2011).

Timeliness. Timeliness is defined as the degree to which patient care information is relayed promptly to the people who need to be informed (Shortell et al., 1991). Viewed through the lens of social network theory and analysis, perceptions of timely communication are a function of the interconnectedness among nodes (density, APL, and diameter) and communication flow (degree centralization). Density described the interconnected ties among staff. Greater interconnectivity and a decentralized communication structure (low in-degree centralization) rather than hierarchical (high in-degree centralization) provide alternate communication channels for information to travel from node A to node B. APL and diameter quantify the average number of ties from node to node. Timely communication is more likely to occur among intradisciplinary nodes co-located in the same social network compared to interdisciplinary communication through boundary spanning ties between social networks (J. S. Brown & Duguid, 2001; Creswick et al., 2009; Patterson et al., 2013; Pentland et al., 2011; Wensing et al., 2011).

In conclusion, communication quality describes staff perceptions of communication in terms of openness, accuracy, and timeliness. The construct was adapted from relational coordination theory (Gittell, 2002), the National ICU Study (Shortell et al., 1991, 1992), and

research utilization literature. Support for the hypothesized link between communication patterns and communication quality came from relational coordination theory and social network theories. Examples in support of the proposed link were taken from social network and research utilization literature. In this study, communication quality was hypothesized to be directly related to EBP adherence, described under EBP adherence. An indirect relationship to preventable hospital readmission rates was also hypothesized. Communication quality described communication among staff on the hospital unit, but it did not describe the working relationships between acute care staff and post-acute care staff.

Relationship quality (Stage 2). Conceptualization for the Stage 2 construct, relationship quality, was drawn from Gittell's (2002) relational coordination theory, quality improvement literature (Shortell et al., 1991, 1992), and transitional care literature (Boutwell, Griffen, Hwu, & Shannon, 2009; Boutwell et al., 2011; Kripalani et al., 2007; van Walraven et al., 2010, 2011). In the conceptual model, relationship quality was comprised of one concept, unit relations. Shortell et al. (1991) define unit relations as the degree to which the quality of relationships with other units in the hospital facilitated ICU performance. For this study, unit relations was defined as the aggregate of individuals' perceptions of the working relationship with the other team. In short, it described how staff in one environment perceived the working relationship with staff in another environment.

In this theoretical model, there was a direct relationship from communication patterns (Stage 1) to relationship quality. There was also a direct relationship between relationship quality and preventable hospital readmission (Stage 4), which will be described under that construct.

Communication patterns and relationship quality. The theoretical model for the study hypothesized a link between communication patterns and relationship quality. Support for this

relationship was informed by relational coordination theory and the literature on transitional care to prevent hospital readmissions. Relational coordination theory applies to independent groups working together to achieve a common outcome. Interventions that established and improved cross-continuum relationships, such as workgroups comprised of members from across the care continuum, provide a venue to establish or strengthen relationships and improve communication across settings (Boutwell et al., 2009). Outcomes can include process co-creation to reduce preventable hospital readmissions (Cortes, Wexler, & Fitzpatrick, 2004), verbal discharge summaries between settings (Hess et al., 2010), and better referrals between settings (Robinson & Street, 2004).

Relationship quality refers to the aggregate perceptions of the working relationships between groups such as between hospital staff and post-acute care staff. The relationship between communication patterns and relationship quality was supported using relational coordination theory and literature on transitional care to avoid hospital readmission. At present the connection between these constructs is only theoretical in nature. There were no empirical studies at this time which support the relationship.

Evidence-based practice adherence (Stage 3). Conceptualization for the Stage 3 construct, EBP adherence, was drawn from diffusion of innovations theory (Rogers, 1995). In the conceptual model, EBP adherence was the rate of documentation for three of nine evidence-based tasks adapted from Project BOOST (Allendorf & O'Sullivan, 2014) and Project RED (Jack et al., 2009) that have been demonstrated to reduce preventable hospital readmissions (see Table 2). The complete set of tasks was referred to as the Care Transition Bundle.

Table 2

Tasks Comprising the Care Transition Bundle

Care Transition Bundle Tasks
8P Risk Assessment[1]
Risks addressed
Discharge checklist
Teach back
Discharge Summary within 72 hours
Patient advised to seek a follow-up appointment within 7 days
Follow-up appointment scheduled
Appointment scheduled within 7 days
Medication reconciliation

This construct was comprised of three tasks from the Care Transition Bundle (see Table 2): (a) 8P risk assessment, (b) medication reconciliation, and (c) discharge summary within 72 hours. The 8P risk assessment was a multi-pronged approach to assess the likelihood of patient readmission based on eight factors associated with readmission. Medication reconciliation refers to a process in which medications prescribed at discharge are compared with current medications and assessed for interaction and redundancy (The Joint Commission, 2006). Discharge communication refers to communication between inpatient providers and providers at the next point of care including primary care, home care, and long-term care. The specific tasks were selected because they required communication among members of the same social network, that is, staff nurses and CNAs on the unit, as well as communication between social networks comprised of discharge planners, physicians, or pharmacists. There were other tasks in the Care

[1] 8P stands for Problem medication, Psychological, Principal diagnosis, Polypharmacy, Poor health literacy, Patient support, Prior hospitalization, Palliative care

Transition Bundle requiring communication between social networks; however, these tasks reflected patient-provider communication which was outside the scope of this study.

In this model, there were hypothesized links from communication patterns and communication quality to EBP adherence which had not been tested empirically. A relationship between EBP adherence and preventable hospital readmission rate (Stage 4) was also hypothesized, described under the Stage 4 construct.

Communication patterns and evidence-based practice adherence. Theoretical support for the hypothesized relationship between communication patterns and EBP adherence was grounded in diffusion of innovations theory (Rogers, 1995) where the communication patterns corresponded to Rogers' communication channels, which were further defined using social network concepts. The rate of adherence to these three evidence-based tasks from the Care Transition Bundle described diffusion of the innovation.

Two EBP evaluation frameworks, the Ottawa Model of Research Use (OMRU) (Logan & Graham, 1998) and PARIHS (Kitson, Harvey, & McCormack, 1998) are congruent with Rogers' (1995) theory and provided support for the link between communication patterns and EBP adherence. Within these frameworks, organizational setting, physical layout, boundaries, and culture describe Rogers' (1995) social system; decision-making authority, leadership, peer influence, and endorsement describe roles and communication patterns among members of the social system. These elements of the frameworks are evaluated as possible barriers and facilitators to the adoption of EBP. Additional insight into organizational setting and culture can be obtained using social network and analysis. Arling, Doebbeling, and Fox (2011) used social network theory and analysis to augment their evaluation of a Methicillin-resistant Staphylococcus aureus initiative based on the PARIHS framework. The authors explored

boundary spanning and measures of centrality to understand facilitation, a concept from PARIHS which is used to complete a task or to help others change attitudes, ways of thinking, and practice (Helfrich et al., 2010). Standing alone, these frameworks are not interventions, rather they are models to guide exploration of the context, barriers, and facilitators which facilitate or impede implementation of new practice. The OMRU and PARIHS frameworks have been used to primarily as an organizing framework (Botti et al., 2014; Driedger et al., 2010; Fisher, 2014; McCullough et al., 2015; Powrie, Danly, Corbett, Purath, & Dupler, 2014; Sandhaus, Zalon, Valenti, & Harrell, 2009; Sving, Hogman, Mamhidir, & Gunningberg, 2014; Ullrich, Sahay, & Stetler, 2014). Additional examples of the influence of communication patterns on EBP adoption and adherence follow.

Characteristics of the social system could be inferred from the research utilization literature. Nurses reported they lack authority to change practice (Atkinson et al., 2008; Fink et al., 2005; Karkos & Peters, 2006; McCaughan et al., 2002; Schoonover, 2009) or their peers and managers were not interested in learning about and adopting new practices (Fink et al., 2005; Schoonover, 2009). From diffusion of innovations theory, boundary spanners introduced new practice into the unit and opinion leaders influenced members of the social system to adopt and adhere to EBP.

Poor EBP adherence at the unit level suggested that the unit may have had few means to learn about new information or there were stringent guidelines about how work should be done. Reframing these findings through a social network lens, one could have inferred that the unit had a hierarchical organization and high in-degree centralization, a paucity of boundary spanning ties, and little opportunity to learn about new practices through other departments or organizations. EBP adoption and adherence is more likely when nurses had greater exposure to

research (Beke-Harrigan et al., 2008; Burns et al., 2009; Fink et al., 2005). Greater exposure to research included such interventions as grand rounds and research days (Fink et al., 2005) and presence on hospital-wide committees (C. E. Brown et al., 2009; Fink et al., 2005).

Evaluative frameworks such as OMRU and PARIHS, congruent with Rogers' (1995) theory, have been used to explain the barriers and facilitators which influenced EBP adoption and adherence within a particular setting. Social network theory and analysis provided additional depth to the explanation regarding individuals' behaviors based on interconnectivity and centrality within the setting.

Communication quality and evidence-based practice adherence. The model hypothesized a link between communication quality (Stage 2) and EBP adherence, which was grounded in the National ICU Study by Shortell and colleagues (1991, 1992). Within- and between-group communication (openness, accuracy, and timeliness) had been associated with patient outcomes, nurses' satisfaction with physician communication, and research utilization.

H. E. Hansen and colleagues (1999) correlated communication quality with research utilization (defined as the uptake of research into practice) among nurses and physicians in the emergency department. Among physicians, communication openness, timeliness, and coordination together accounted for 47% of the variance of research use in practice. Among nurses, only one variable, communication openness, was associated with research utilization and accounted for only 9.3% of the variance on the dependent variable. H. E. Hansen et al. (1999) suggested that nurse-to-nurse communication was how nurses became aware of innovation and new evidence-based nursing interventions. This finding was expanded in the national study by Pravikoff and colleagues (2005) on nurses' readiness for EBP. In the Pravikoff study, more than

50% of the nurses surveyed obtained information relative to practice from other nurses, which underlines the importance of communication quality.

Preventable hospital readmission (Stage 4). Conceptualization for the Stage 4 construct came from the hospital readmission literature. Preventable hospital readmissions are readmissions related to a previous admission which could have been avoided (Goldfield et al., 2008). It is a multifactoral concept involving patients, clinicians, and care environment factor. Contributors to the preventable readmission rate include poor communication between care settings and low adherence to EBP. While examination of preventable hospital readmissions was beyond the scope of this study, identified clinical processes to reduce preventable hospital readmissions are within the study scope (link between Stage 3 and Stage 4 in the model).

Relationship quality and preventable hospital readmission. Poor communication between care settings is often cited as one of the contributors to hospital readmissions (Golden et al., 2010; Kirsebom et al., 2012; Lamb et al., 2011; Minott, 2008; National Transitions of Care Coalition, 2010; Naylor et al., 2011; Robinson & Street, 2004). The increasingly fragmented health system exacerbates difficulties in communication across the system (American Nurses Association, 2012; French et al., 2009; Naylor et al., 2012; Nosbusch et al., 2011; Parry et al., 2009). Interventions that establish and improve cross-continuum relationships between settings, such as cross-continuum work groups and oral (in addition to written) discharge summaries have been shown to decrease 30-day readmission rates (Cortes et al., 2004; Hess et al., 2010; Robinson & Street, 2004). Using logistic regression analysis, Hess and colleagues (2010) implemented an oral discharge summary and report an odds ratio of .42 (95% CI, .017-1.04; $p = .06$) for readmission. Readmissions decreased from 10% to 5% and the median total cost of care decreased from $148,574 to $111,723 ($p = .002$).

Evidence-based practice adherence and preventable hospital readmission. A direct relationship between EBP adherence and preventable hospital readmission was hypothesized in the model. A number of care transition programs have demonstrated a reduction in preventable hospital readmissions. Risk assessment and discharge summary are elements in the Project BOOST protocol (Allendorf & O'Sullivan, 2014), while medication reconciliation is part of the Project RED protocol (Jack et al., 2009). Described previously, implementation of Project BOOST and Project RED have been shown to reduce preventable hospital readmissions. Early findings from the BOOST intervention reported a reduction in 30-day hospital readmission rates from 14.7% to 12.7% and 13.6% reduction in 30-day all-cause readmission rates (Allendorf & O'Sullivan, 2014). Similar positive findings were reported by L. O. Hansen and colleagues (2013) using a semi-controlled pre-post design. At baseline, the readmission rate for units implementing BOOST was 14.7%, and when measured the following year the readmission rate decreased to 12.7% ($p = 0.10$). The relative reduction was 13.6% and the absolute reduction between the BOOST units and the control units was 2.0% ($p = .054$).

Outcomes from a randomized trial of project RED were also positive. Those in the intervention group ($n = 370$) had a lower rate of hospital utilization than the control group ($n = 368$) 0.314 vs. 0.451 visit per person per month; incidence rate ratio, 0.695 [95% CI, 0.515 to 0.937], $p = .009$) (Jack et al., 2009).

EBP adherence also was hypothesized in the model as a mediator between communication quality and hospital readmission. Studies by Shortell et al. (1992) and Manojlovich and colleagues (2007, 2008, 2009) suggested that communication qualities of openness, accuracy, and timeliness were important to better patient outcomes. Research by Gittell et al. (2000, 2008), Havens et al. (2010), and others which used relational coordination

theory supported the connections between communication patterns, communication quality, and preventable hospital readmission rates.

Shortell and colleagues (1992) stated that open accurate and timely communication was an imperative when coordinating patient care. Higher performing ICUs communicated frequently within the unit and with other units (between-group communication). While EBP adoption and adherence were not specifically explored, nurse-physician communication was found to positively influence the following conditions among ICU patients of pressure ulcers, ventilator acquired pneumonia, and blood stream infections (Manojlovich et al., 2009). In that study, there was a small to medium negative relationship between measures of communication quality and incidence of pressure ulcers, of which timeliness was statistically significant ($r = -.38$, $p < .05$). Studies by Gittell and Havens, described earlier, reported similar findings. Although not explicit, findings from these studies suggested that EBP adherence may be a mediating variable for preventable hospital readmissions.

Summary

The conceptual model, a Relational View of Communication and Adherence to Evidence-based Practice, was used to explore how the communication patterns within the acute care setting affected communication quality within the unit, relationship quality between the hospital and post-acute care teams, and adherence to evidence-based activities to reduce readmission. Diffusion of innovations theory provided overarching support for the relationships among all of the constructs. Social network theories amplified Rogers' (1995) concepts of social system and communication channels, referred to as communication patterns within the model, and support the relationships among concepts. Relational coordination theory provided theoretical support for relationships between communication patterns and relationship quality. Hypothesized

relationships were further supported by findings from research in nursing, quality improvement, and research utilization.

CHAPTER 3. METHODS

The purpose of this chapter is to describe the methods used in this study, including (a) setting, (b) sample, (c) participants, (d) data collection, (e) instrumentation, and (f) analysis plan for the specific aims and research questions. References to the stages of the conceptual model are provided throughout the chapter to demonstrate the linkages between model and methods.

Design

This exploratory descriptive research study used social network analysis to explore the communications patterns (Stage 1) for patient care and patient discharge among nursing (RN, LPN, CNA) and discharge planning staff on adult medical-surgical units. Data from the social network analysis were correlated to measures of communication quality (Stage 2) on the hospital unit, relationship quality (Stage 2) between acute and post-acute settings, and adherence to three evidence-based transitional care tasks (Stage 3).

Setting

The study was conducted at seven hospitals in southern and central Maine; a small part of the study was conducted at six home care agencies and seven long-term care facilities.[2] Maine is a rural state with only two major health systems: one in the northern part of the state and one in the southern half of the state. Four hospitals were members of the local health system and three hospitals were affiliate members of that system. Member and affiliate organizations differed in that affiliate organizations were not required to adhere to health system policies and procedures. Five of the seven hospitals were community hospitals; one of the five hospitals held Magnet designation. Characteristics of Magnet designated hospitals include low employee turnover and greater employee satisfaction and a strong emphasis on EBP and patient safety. Relevant to this

[2] *Due to changes in the analysis plan, six hospitals, five home care agencies, and six long-term care facilities were included in the final sample.*

study, Magnet designation requires demonstrated use of research in practice. The remaining two hospitals were critical access hospitals; hospitals designated as critical access are usually located in rural areas and have limited inpatient and outpatient services. A description of the study sample follows.

Sample

The unit of analysis for this research was the hospital nursing unit. The primary sample was comprised of 13 adult medical-surgical units from the seven hospitals. Criteria for inclusion within the sample were adult medical-surgical unit and the adoption and measurable adherence of three evidence-based transitional care tasks: (a) 8P risk assessment at the time of admission on the unit, (b) medication reconciliation at the time of discharge, and (c) transmission of the discharge summary to the post-acute point of care as part of the patient discharge workflow. These identified tasks were included within a set of tasks referred to as the Care Transition Bundle, an evidence-based protocol adapted from Project BOOST (Allendorf & O'Sullivan, 2014; Jencks et al., 2009; Society of Hospitalist Medicine, 2008) and Project RED (Jack et al., 2008). Health system leaders recommended adoption of the Care Transition Bundle to member and affiliate hospitals as part of a workflow to reduce preventable hospital readmissions, although not all hospitals had adopted all of the tasks within the bundle. Two tasks within the Care Transition Bundle were required by the Centers for Medicare and Medicaid (medication reconciliation and discharge summaries) and a high rate of adherence to these tasks was expected.

Patients who were candidates to receive the Care Transition Bundle included all adult patients, with the exception of obstetrics and gynecology. Differences in hospital designations required that the unit exist in both community and critical access hospitals and patients on the

unit were likely to be discharged to home care agencies or long-term care facilities. Adult medical-surgical units met these criteria.

In order to evaluate the cross-continuum relationships between hospital staff and post-acute care staff, a sample of post-acute providers comprised of six home care agencies (two hospitals used the same home care agency) and seven long-term care facilities were also included in the study. To be included within the post-acute sample, home care agencies and long-term care facilities were identified by the unit leaders as organizations where patients were discharged most frequently. Relationships between hospital and post-acute settings (relationship quality) were measured as part of the Stage 2 construct in the model.

Sample Size

Sample size requirements were based on analysis at the unit level. A sufficient number of units, rather than individuals, were required to obtain strong correlations between variables within the model. To ensure that a sufficient number of units had been recruited into the study, a power analysis was performed using the statistical power calculator from the Wake Forest University School of Medicine (2015). Although data were collected from 13 units, a sample size of 10 was used for the power analysis to account for any units that may have had to be dropped from the study. Input variables required for the power calculations included (a) significance, (b) number of sides (tails), (c) null hypothesis correlation, (d) alternative hypothesis correlation, and (e) sample size. See Table 3 for the calculated power for each alternative correlation.

Table 3

Power Analysis

Significance	Number of Sides	Null Correlation	Alternative Correlation	Sample Size	Power
0.1	2	0	0.5	10	0.458
0.1	2	0	0.6	10	0.617
0.1	2	0	0.7	10	0.784
0.1	2	0	0.8	10	0.925
0.1	2	0	0.9	10	0.993

Depending upon the alternative correlation value, the power for this study (using a sample size of 10) ranged between 0.458 and 0.925 and suggested a large effect size.

While a sufficient number of units were required to achieve an adequate sample size, an adequate number of individuals (a percentage within each unit) was also required. Responses from individuals were aggregated to achieve a unit level response; a response rate of 40% or greater is suggested, (Kramer et al., 2009). A sufficient percentage of responses was also required to perform a robust analysis of the communication patterns, although a limited social network analysis can be performed with low response rates (Borgatti, Carley, & Krackhardt, 2006; Costenbader & Valente, 2003). Ideally, a 50% response rate or greater is required to analyze the communication patterns within the social network with respect to structure in addition to relationships. A description of the participants within the sample is addressed in the next section.

Participants

As noted, the unit of analysis for this research was the nursing unit. Participants for the sample included nursing (RN, LPN, CNA) and discharge planning staff from the hospital unit and identified staff from the post-acute settings who were in regular contact with the hospital unit.

Hospital staff. Data were collected from nursing (RN, LPN, CNA) staff on each of the 13 units, and from discharge planning staff assigned to cover those units. Certified nursing assistants were included in the study because, as important and full members of the nursing care team since, under the direction of a licensed nurse, they have responsibility for carrying out evidence-based patient care activities, such as hourly rounding, mouth care, repositioning, and ambulating which, if not performed, could contribute to a hospital readmission (J.D. Evans, personal communication, April 6, 2015). Discharge planners, usually nurses and social workers, were identified by the unit nurse manager as those individuals most often assigned to the unit. All nursing and discharge planning staff who (a) could speak and read English; (b) worked day or evening shift full-, part-time, per diem, or travelling; (c) had been employed for at least six months; and (d) worked at least 40% during the prior 30 days were eligible to participate. An engagement of six months was required to assure familiarity with the formal and informal unit culture and to increase the likelihood that the responses reflected a group norm upon aggregation at the unit level (Kozlowski & Klein, 2000). Fluency in English was required to comprehend and respond to the survey. See Table 4 for hospital health system affiliation, number of participating units from each hospital, number of beds per unit, and the number of staff eligible to participate in the study.

Table 4

Hospital and Unit Characteristics

Hospital Information		Unit Information			
Hospital	Unit	Beds Per Unit (Allocated)	RN Count	CNA Count	Discharge Planner Count
1*	1.1	24 / (33)	41 (7 travel)	17	3
	1.2	22 / (31)	44	19	
	1.3	29	42	18	2
2	2.1	23	30	8	3 across all units
	2.2	23	30	8	
3	3.1	19	24	12	4
4	4.1	23	44	24	4
5	5.1	28	30	13	10 across all units
	5.2	40	41	16	
	5.3	9	19	6	
6*	6.1	31	17	8	6 across all units
	6.2	20	18	9	
7*	7.1	54	69	30	11

Note: RN: Registered Nurse; CNA: Certified Nursing Assistant;
* Affiliate member of the health system

Home care and long-term care staff. Inclusion criteria for home care and long-term care staff included (a) regular communication with the hospital's nursing or discharge planning staff regarding patient admission and readmission to the agency or facility speak and read

English; (b) work day or evening shift, full-, part-time, or travelling; (c) employed for at least six months; and (d) worked at least 40% during the prior 30 days. Directors of nursing or nurse managers from the home care and long-term care organizations identified staff who met the inclusion criteria.

This section described the research setting, sample, and participants for this research. The primary research setting was the seven hospitals in Maine. The primary sample was comprised of 13 adult medical-surgical units; the participants were nursing (RN, LPN, CNA) and discharge planning staff who worked on the unit. Six home care agencies and seven long-term facilities were included in the setting as part of the measure of relational quality (Stage 2), and staff from these organizations were included as participants for this measure. A description of the instruments and survey administration to participants follows.

Instrumentation

This section describes the instruments that were used to operationalize each concept in the conceptual model. The order of the instrument descriptions follows the conceptual model described in Chapter 2. Table 5 provides a crosswalk summary from construct to instrument and the information source. Copies of each of the instruments are provided in Appendix A.

A four-part survey consisting of demographic questions and measures of communication patterns, communication quality, and relationship quality was administered to nursing (RN, LPN, CNA) and discharge planning staff on the adult medical-surgical units. A three-part survey consisting of demographic questions and measures of communication patterns and relationship quality was administered to staff at the identified home care and long-term care organizations. Survey items related to communication quality addressed intra-unit communication and were not administered to participants in the post-acute care settings (home care and long-term care).

Table 5

Construct Instrument Crosswalk

Construct	Concept	Instrument	Data Obtained From
Communication Patterns (Stage 1)	Density In-degree centralization Core-periphery Average path length Diameter	2 items regarding who talks to whom regarding patient care and discharge planning	RN, CNA, DP, nurse manager
Communication Quality (Stage 2)	Communication openness Accuracy Timeliness	Nurse-Physician ICU Questionnaire (within-group communication)	RN, CNA, DP, nurse manager
Relationship Quality (Stage 2)	Relational agreement	Nurse-Physician ICU Questionnaire (unit relations with other units)	RN, CNA, DP, nurse manager Post-acute care nursing staff
Adherence to EBP (Stage 3)	Risk assessment Medication reconciliation Discharge summary		Hospital information system

Note. DP = discharge planner

Demographic items. The demographic section of the survey consisted of eight items: (a) role, (b) education level, (c) shift, (d) full- or part-time status, (e) professional tenure, (f) organizational tenure, (g) engagement in the workplace, and (h) engagement in professional organizations Demographic data were used to describe unit composition and to subset data for analysis.

Communication patterns. Social network data obtained through means of a survey reflect a set of relationships related to a specific phenomenon or activity of interest; social network analysis quantifies these relationships in terms of interconnectedness and node position

within the structure of the social network. While survey items may be constant, measures of interconnectedness and node position within the structure of the social network change with changes in participants and over time. Because of the dynamic nature of the relationship between activity and respondent, items designed to measure the social network are created with a specific research question and participants in mind; guidelines are available to inform item construction (Borgatti et al., 2013; Hanneman & Riddle, 2005).

Communication patterns on the hospital unit were operationalized through social network analysis, a method used to quantify relationships among individuals within a specific hospital unit and the overall structure of those relationships. Concepts of density and in-degree centralization reflect who has relationships with whom within the unit and the structure of the social network as defined by those relationships. Concepts of average path length and diameter describe the average distance between nodes in the social network and the concept of core-periphery describes the distribution of nodes within the social network. Two investigator-designed questions were used to measure the construct communication patterns and the concepts of density, in-degree centralization, core-periphery, average path length, and diameter related to patient care and patient discharge (Stage 1) among nursing (RN, LPN, CNA) and discharge planning staff on the adult medical-surgical unit and with other staff outside of the unit, including home care agencies and long-term care facilities. For each question, participants were presented with a roster of names comprised of the nursing (RN, LPN, CNA) and discharge planning staff who worked on the unit during the past 30 days and the names of the designated home health and long-term care organizations. Participants could also add a total of four names and organizations. For each name or organization, participants indicated their frequency of communication using a 5-point Likert scale: *don't know person; know, but don't talk to them;*

monthly; weekly; and *daily*. A roster format providing a list of names to participants (such as used in this survey) has been shown to improve name recall and decrease selection bias (Borgatti et al., 2013).

Two similar investigator-designed questions regarding communication patterns and frequency regarding staff communication patterns with the adult medical-surgical units at the hospital were included in the post-acute care survey. Participants indicated their frequency of communication with hospital unit staff for each unit using a 4-point Likert scale: *almost never; 1-2 times a month; weekly*; and *daily*. Responses were used to explore the frequency of communication between post-acute care settings and the hospital unit regarding patient discharge.

Items in the communication patterns section of the survey were used to describe the patterns and frequency of communication among nursing (RN, LPN, CNA) and discharge planning staff and with external staff and organizations. These items describe who talks to whom regarding patient care and patient discharge and the frequency of communication, but not the quality of the communication.

Communication quality. The measure of communication quality section (Stage 2) incorporated individuals' perceptions of the openness, accuracy, and timeliness of communication among unit staff. Communication quality was measured using the ICU Nurse-Physician Questionnaire (Shortell et al., 1991) within-group communication scale, comprised of three subscales: (a) within-group openness (four items), (b) within-group accuracy (four items), and (c) within-group timeliness (three items). Each subscale was listed twice: once for nursing (RN, LPN, CNA) staff and again for discharge planning staff. These subscales have been used to measure communication among members of the same discipline (within-group communication)

and between disciplines (between-group communication) in the acute care setting (H. E. Hansen et al., 1999; Manojlovich & Antonakos, 2008; Manojlovich et al., 2009; P. A. Miller, 2001). In addition, the subscales have been adapted for use in long-term care settings (H. E. Hansen, Bull, & Gross, 1998; Temkin-Greener, Gross, Kunitz, & Mukamel, 2004).

Item stems were adapted with the author's permission for relevance within the adult medical-surgical setting. Stems were changed from *It is easy for me to talk openly with the nurses of this ICU* to *It is easy for me to talk to nursing staff (discharge planners) of this adult medical-surgical unit*. Items were measured using a 5-point Likert scale ranging from 1, strongly disagree to 5, strongly agree. In studies which have used these subscales, internal consistency for the communication openness subscale ranges between 0.80 and 0.86 (Adler-Milstein, Neal, & Howell, 2011; Fernandez, Tran, Johnson, & Jones, 2010; H. E. Hansen et al., 1999; Shortell et al., 1991), 0.75 to 0.78 for the communication accuracy subscale (Adler-Milstein et al., 2011; Fernandez et al., 2010; Shortell et al., 1991) and 0.64 to 0.82 for the communication timeliness subscale (Adler-Milstein et al., 2011; Fernandez et al., 2010; H. E. Hansen et al., 1999; Shortell et al., 1991).

One of the four items (item 2) was removed from the ICU Nurse-Physician Questionnaire communication openness scale (Shortell et al., 1991):

1. It is easy for me to talk openly with the [nurse]s of this ICU.
2. Communication between [nurse]s is very open.
3. I find it enjoyable to talk with other [nurse]s of this unit.
4. It is easy to ask advice from [nurse]s in this unit.

Items 1, 3, and 4 of the scale reflect individuals' relationships with other staff, while the second item, *Communication between nurses in this unit is very open*, reflects an observation of the entire unit. Scale items based on personal experience (1, 3, 4) were more congruent with the

communication pattern section of the survey; for this reason the second item was removed from the scale. No other scale items were removed for this study.

Items in the communication quality section of the survey were adapted from the ICU Nurse-Physician Questionnaire within-group communication scale (Shortell et al., 1991). These items were intended to measure adult medical-surgical unit nursing (RN, LPN, CNA) and discharge planning staff's perceptions of the intra-unit communication qualities of openness, accuracy, and timeliness. Working relationships between the hospital unit and the post-acute staff in home care and long-term care (Stage 2) are addressed in the next section, relationship quality.

Relationship quality. Relationship quality, also Stage 2 in the model, refers to the perceptions of one group's working relationship with another group. As noted in the previous section, item stems from the unit relations with other units scale in the ICU Nurse-Physician Questionnaire (Shortell et al., 1991) were adapted with the author's permission to address the relationships between the medical-surgical unit and the post-acute care environments. Item stems were changed from *Our unit has…other hospital units* to *Our unit has …..home care organization (or long-term care facility)*. Specifically, hospital staff survey items were modified to reflect the working relationships with home care agencies and long-term care facilities; home care and long-term care staff survey items were modified to reflect the working relationships with hospital adult medical-surgical unit(s) staff. Items were measured using a 5-point Likert scale ranging from 1, strongly disagree to 5, strongly agree. Among studies that have used this scale, internal consistency ranged between 0.68 and 0.75 (Fernandez et al., 2010; Shortell et al., 1991). In conclusion, the relationship quality scale (referred to as relationship quality, Stage 2 in

the model) was used to measure working relationships between the unit and the post-acute care organizations.

Evidence-based practice adherence. Adherence to EBP (Stage 3) was a process measure of unit-based performance for three evidence-based tasks which are thought to reduce preventable hospital readmissions (Jack et al., 2009; Jencks et al., 2009). Documentation of task adherence was obtained from the hospitals' information system, which may have included the electronic medical record (EMR). Task adherence was calculated as a rate where the number of discharged patients from the unit in the 30-day period was the denominator and the number of discharged patients for whom the task was documented in the EMR as completed was the numerator.

This section described the instruments that were used to measure concepts within the conceptual model. Ten items in the survey were investigator-designed; eight were demographic items, and two were communication pattern items. Two scales were adapted from the ICU Nurse-Physician Questionnaire (Shortell et al., 1991): (a) within-group communication, and (b) unit relations with other units. Documentation of adherence to three evidence-based tasks was obtained from the hospitals' information systems. Procedures for recruitment, survey administration, and data collection are described in the next section.

Procedures

The primary setting for this study was the adult medical-surgical unit, Data also were collected from staff in designated home care agencies and long-term care facilities. The survey was available either in hard copy or online. Procedures to recruit sites and to prepare, administer, and collect data were dependent upon the setting (hospital, home care agency, or long-term care facility), and the method of survey administration (paper or online).

Recruitment. Prior to Institutional Review Board (IRB) approval, the investigator sent an email of inquiry to member and affiliate hospitals Chief Nursing Officers (CNOs). The email described the study purpose and types of data that would be collected (see Appendix B). A brief biography of the investigator and the study abstract were also provided. As a means to introduce the concept of social networks and their application to patient safety to the CNOs, an article by Hofmeyer and Marck (2008) was attached to the email message. The investigator telephoned any CNO who had not responded after three weeks to gauge organizational interest in participating in the study. Upon receiving confirmation of the CNO's interest to participate, the investigator met with the CNO and/or unit nurse managers to discuss staff inclusion criteria, mode of survey administration (paper or online), and to identify the home care agency and long-term care facility where the unit most frequently discharged patients. Directors of nursing and other nurse managers in the identified home care organizations and long-term care facilities were contacted using the same process just described. Survey administration and distribution was based in part on whether the participants were from the hospital unit, home care agency, or long-term care facility (see Figure 2).

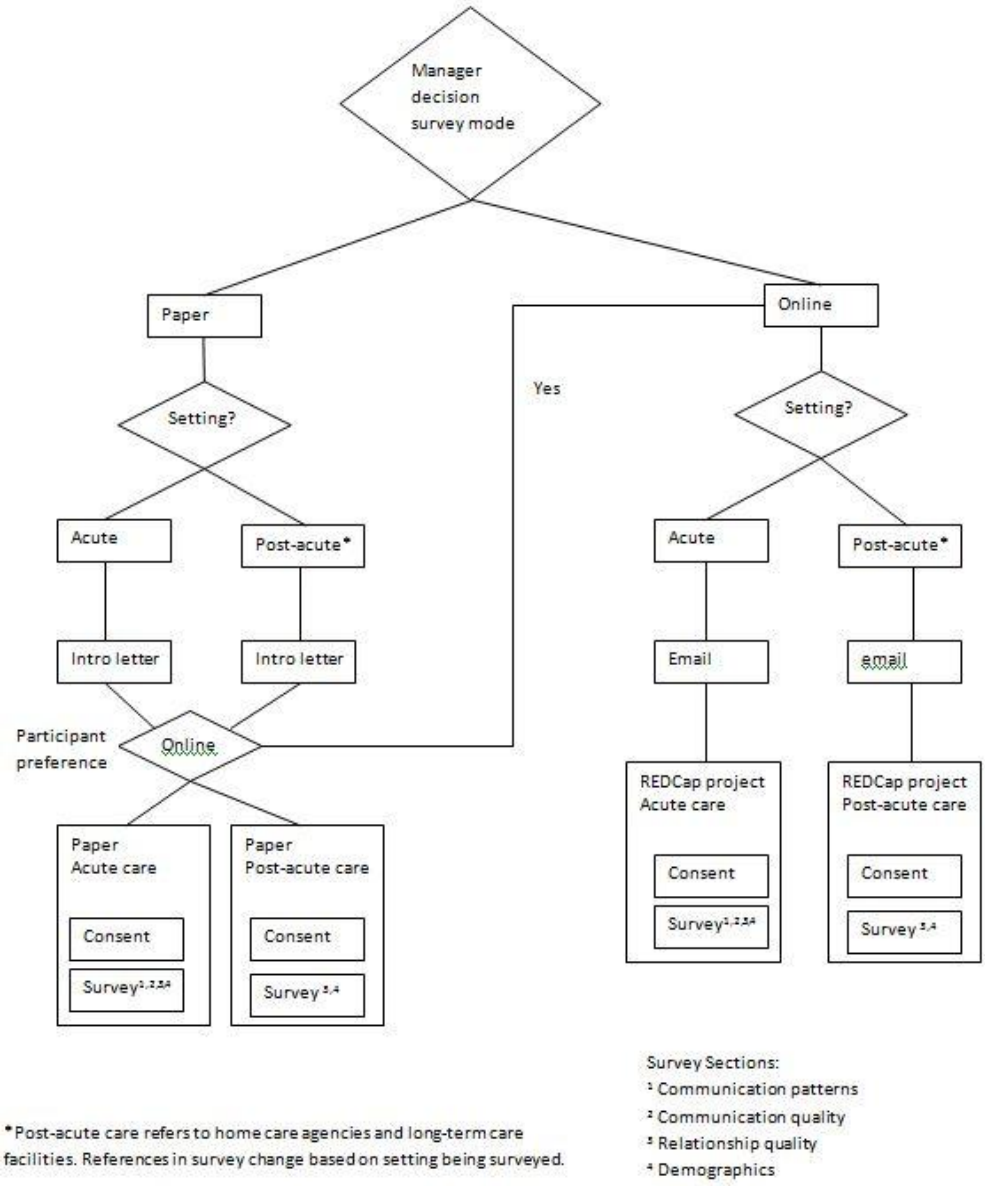

Figure 2. Survey Distribution Workflow.

Survey administration and distribution. Hospital unit and post-acute care organization nurse leaders were offered a choice of using paper surveys or online surveys during the initial meeting with the investigator. The health system's IRB advised using online surveys, since in their experience, online survey administration was more convenient, secure, and provided greater anonymity than paper surveys. In addition, error checking could be enabled by survey item. The online survey was able to be completed using a computer, tablet, or smart phone (essentially using any technology with an internet connection). Responses were entered directly into the database by the participant, negating the need for additional data collection, error checking, and data entry activity.

All of the adult medical-surgical units, one home care agency, and three long-term care facilities opted to use paper surveys. Paper survey packets contained the survey, a consent form for the participant's records, a letter of introduction (see Appendix C), and a return envelope. The introductory letter to participants included a description of the research study, instructions for completing the survey, and identified the location of the survey collection box within the unit or facility. The letter also included a link to the online survey should the participant prefer online to a paper survey. Participants from sites using online surveys did not have the option to complete a paper survey. Survey packets and introductory letters included participants' names; the surveys and return envelopes were labeled with an identification number only.

On the first day of the data collection period for sites using paper surveys, the investigator delivered survey packets to the unit or organization leaders for staff distribution (four hospitals) or placed the survey packets in staff mailboxes (three hospitals). A sealed box to collect the completed surveys was placed in a central location, usually at the nurses' station or the break room.

The investigator obtained email addresses for the staff from the home care agencies and long-term care facilities using online surveys. On the first day of the data collection period, the investigator sent an introductory email to those staff explaining the research study and the link to the online version of the survey.

Process for recruitment, survey administration, and distribution were described in this section. The processes varied depending upon the participants' location and nurse managers' preferences for survey administration. Data collection procedures are described in the following section.

Data collection. As the first step of the data collection process, nurse managers of the adult medical-surgical units and post-acute care environments received an email drafted by the investigator to forward to their staff which included a description of the survey process and the date when data collection would begin. Start dates for data collection were staggered to allow adequate time for the investigator to modify the survey to include the roster of staff names for each unit and assemble the survey packets for each constellation comprised of hospital, home care agency, and long-term care facility.

The investigator visited the adult medical-surgical units during each week of the four-week data collection period. Post-acute care sites (one home care agency and three long-term care facilities) were visited twice during the four-week data collection period due to a smaller number of participants. Site visits served two purposes. The first purpose of the site visit was to exchange data collection boxes in order to report each unit's participation rate for the week. The second purpose of the visit was so that the investigator could engage with staff to answer questions and talk about the project.

Within a few days of collecting the completed surveys from the adult medical-surgical units, the investigator emailed the nurse managers with their unit's weekly and cumulative staff response rate (see Appendix D). Response rates of 50% or more were needed to perform robust social network analysis on the communication patterns data (Stage 1) and to aggregate individual data to the unit level. To encourage participation, the investigator offered a monetary incentive; units were eligible to receive $100 if they achieved a 50% response rate and $200 if they achieved an 80% response rate.

This section described the data collection activities for sites using paper surveys, specifically the 13 hospital units, one home care agency, and three long-term care facilities. Weekly site visits provided an opportunity to exchange survey collection boxes and engage with staff. High participation is important for social network analysis. Weekly emails were sent to unit leaders to apprise them of their staff's response rate. Hospital units were incented to achieve a 50% or greater response rate. The next section describes the plan for human subjects' protection and data management processes.

Data Management/Plan for Human Subjects

This section describes the plan for human subject protection and the data management plan. Approvals from four IRBs, three based in Maine and the fourth in Arizona, were obtained by the investigator. Participant names were de-identified, except as part of the communication patterns (Stage 1) section of the survey, and a signed consent form was not required.

Plan for human subject protection. Institutional Review Board approval was obtained from four institutions: (a) MaineGeneral Health, (b) St. Mary's Regional Medical Center, (c) Maine Medical Center which also serves MaineHealth, and (d) Arizona State University. Copies of the approvals are located in Appendix E. Responsibility for research oversight was

shared between the hospital-based IRBs and the university IRB. Hospital IRBs were responsible for overseeing recruitment and data collection; the university IRB was responsible for overseeing the data analysis. Data anonymity, an aspect of human subject protection, is described in the next section.

Data anonymity. Participants' names from the adult medical-surgical units were listed in the adult medical-surgical unit version of the survey as part of the communication patterns section. Only de-identified participant names were used during the data analysis. Each participant was assigned a unique identifier, referred to as a participant ID, comprised of a two-digit location code and a randomly generated four-digit number. An electronic master list that served as a cross-referenced list of names and IDs was maintained on a separate database within Research Electronic Data Capture (REDCap), a secure, web-based, survey administration application and database (P. A. Harris et al., 2009). The master file provided a means to match staff names and participant IDs if a participant ID had been entered incorrectly in the online survey or if a participant ID was used more than once. Master files will be destroyed once the study is completed.

This section described the plans for human subjects' protection and data management. Approvals for this research were obtained from IRBs in Maine and Arizona. Research oversight was shared between participant recruitment, under the purview of the Maine-based IRBs and data analysis, under the purview of the university IRB. Participant anonymity was met through the use of a de-identified participant ID code. Details regarding the software selected for analysis and the procedures to cleanse and reformat the data prior to analysis follow.

Analytical Software and Data Analysis Preparation

This section describes the analytical software and procedures used to clean, format, and prepare variables for model testing. Two software programs were used for data analysis. One program, UCINet (Borgatti, Everett, & Freeman, 2002), was used to analyze the communication patterns data, and the other program, SPSS (IBM Corporation, 2010), was used to perform statistical analysis. Social network analysis techniques were used to calculate values for the communication patterns (Stage 1), variables, density, in-degree centralization, core-periphery, average path length, and diameter. Statistical techniques were used to calculate and analyze individual and group level scores for Stage 2 variables openness, accuracy, timeliness, and relationships with others. Stage 3 variables (risk assessment, medication reconciliation, and discharge summary) were calculated as a rate using data from the hospital information systems.

Software. Software for data preparation and analysis included Microsoft Excel (Microsoft, 2007), UCINet version 6 (Borgatti et al., 2002) for social network analysis, and SPSS version 22 (IBM Corporation, 2010) for statistical analysis. Microsoft Excel was used as an intermediate data preparation platform prior to importing data into an analytical package. UCINet (version 6) was used to analyze communication patterns (Stage 1) and demographic data for social network analysis. SPSS (version 22) was used to describe and evaluate the reliability and validity of the communication quality and relationship quality measures (Stage 2) and to test the relationships across stages of the conceptual model.

Data entry and error checking. This section describes a set of activities beginning with data entry for paper surveys and culminating with data aggregated to the group level, ready for model testing. Some data were analyzed using social network techniques while other data were

analyzed using statistical techniques. The processes are different for each data type (see Figure 3), therefore the explanations are described separately.

Paper survey data were entered into REDCap by the investigator. Some preliminary data cleansing occurred as part of the data entry process. For example, data cleansing was required in the case of duplicate IDs since REDCap would reject the record, or in cases in which two responses were selected. When two participants used the same participant ID, the duplicated ID was resolved by the investigator through a process of elimination based on role and other demographic data. In some cases, role and demographic information was not sufficient; in these cases, the investigator would have to contact the nurse manager, providing role, tenure, and the names of possible individuals. Other than responses to select demographic items, no other survey items were communicated to the nurse manager.

When two responses were selected for a question, the response indicating greater frequency or level of agreement was used. Simply put, if both *daily* and *weekly* were circled under communication patterns, *daily* was chosen. If *agree* and *strongly agree* were circled under communication quality or relationship quality, *strongly agree* was chosen.

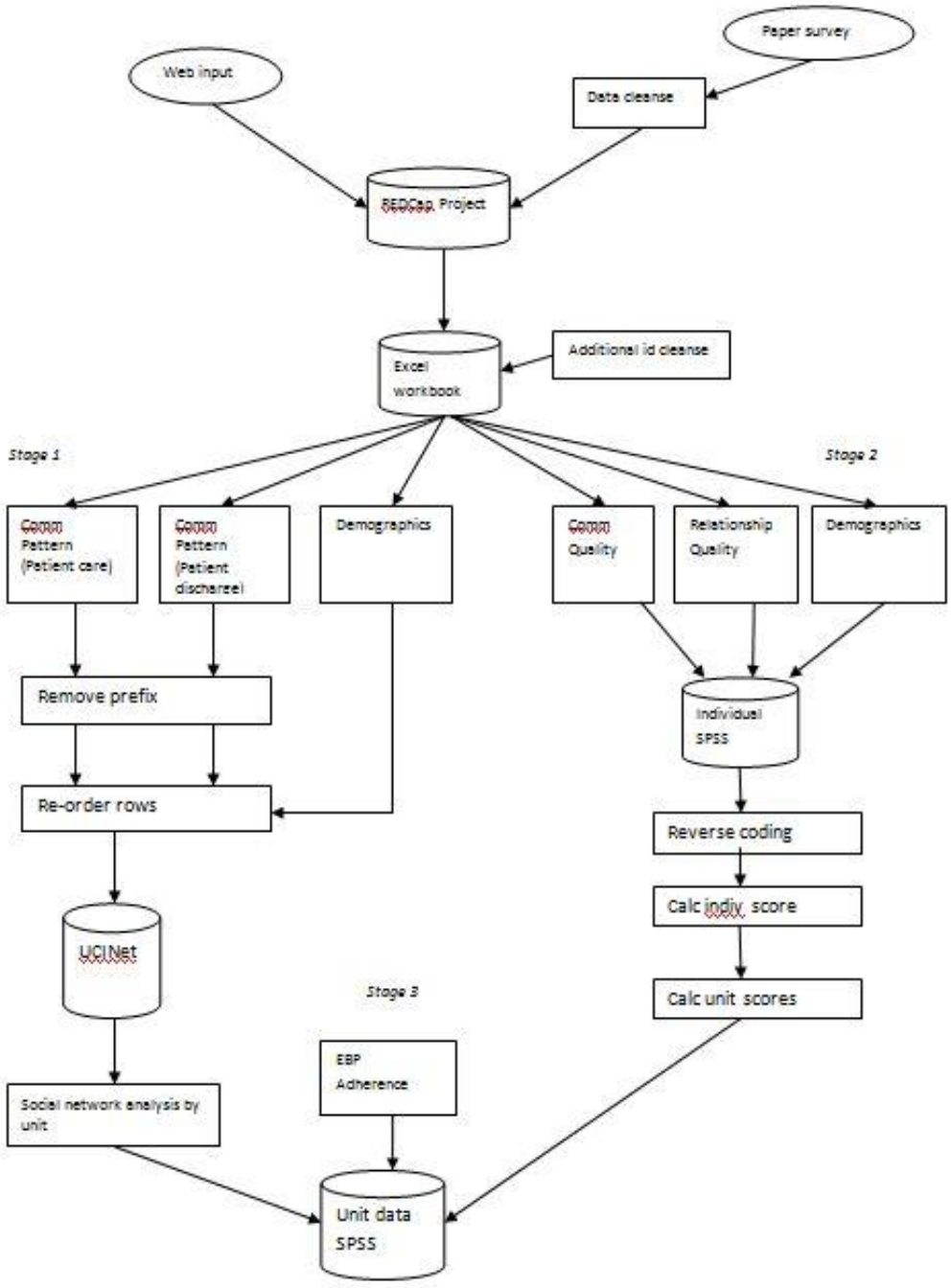

Figure 3. Data Preparation Workflow.

Once all of the data for each site had been entered, the REDCap database was exported to an Excel workbook. Some participants who elected to take the survey online provided their name as their participant ID, requiring additional participant ID data cleansing within Excel. REDCap could not be programmed to perform error checking on participant IDs. Incorrect names in the Excel spreadsheet were replaced with the correct participant IDs from the master file.

Next, data in the large excel spreadsheet were subdivided by data type, responses to communication patterns, or communication and relational quality items. Communication patterns for patient care and patient discharge communication pattern, and demographic data were copied into separate spreadsheets. Communication quality, relationship quality, and demographic data were copied into a separate spreadsheet. Separate spreadsheets for each type of data analysis, social network or statistical, facilitated the process of importing the data into the social network or statistical software package. The next section describes the data preparation for each type of data prior to importing into the analysis software, and preparing the variables for model testing.

Data preparation: Communication patterns. Social network techniques were used to create the operational variables for the communication patterns construct in Stage 1. Procedures for data entry, cleaning, and creation of the measures for density, in-degree centralization, core periphery, average path length, and diameter are described. UCINet requires that variable names were free of punctuation (see variable renaming), and row headers and column headers in the spreadsheet are listed in the same order (see reordering). This section concludes with a description of how the variables were calculated in UCINet.

Variable renaming. Participant IDs were also the variable names within the communication patterns data. To differentiate participant ID variables for patient care and patient discharge within REDCap databases, variables were prefixed with either *pc-* for patient care or

dc- for patient discharge. These prefixes were removed from the column and row headers in the Excel spreadsheets.

Reordering. Variables were listed in the first row (column headings) and respondents' participant IDs were located in the first column of the spreadsheet (row headings). Variables (column headings) were listed alphabetically by staff name within the REDCap database; survey responses (rows) were ordered by time of data entry. Reordering required shuffling the rows, or cases, such that the order of the row headings matched the order of the column headings. New rows were inserted to reflect non-respondents, and their corresponding participant IDs were entered in the first cell (row heading) of the newly inserted rows.

Within UCINet, demographic data were matched on participant ID, thus the participant IDs in the demographic data spreadsheets had to match the order of the participant IDs in the patient care and patient discharge communication patterns spreadsheets. Demographic data were reordered to match the communication pattern order, including blank rows with the non-respondents' participant ID in the first cell in the row.

Variable calculations. Patient care, patient discharge, and demographic Excel spreadsheets were imported into UCINet where additional data modification to communication patterns data was required prior to analysis. Blank cells in the communication pattern matrices were filled with zeros. Some social network analyses require binary data. Values of one and two (corresponding to *don't know* and *don't talk to about* in the survey) were re-coded to zeros, signifying no relationships. Responses of three and higher (corresponding to *monthly*, *weekly*, and *daily* in the survey) were re-coded to ones, signifying a relationship.

Social network measures. Social network analysis was used to quantify the communication patterns for patient care and patient discharge (Stage 1). Measures of the social

network structure (including density, in-degree centralization, core-periphery, average path length, and diameter) were calculated from the communication patterns data. This discussion provides an explanation of how these measures are calculated and interpreted.

Density, a measure of interconnectivity within the social network, is calculated as a rate where the numerator corresponds to the count of actual ties within the social network and the denominator corresponds to the maximum number of possible ties within the social network. A value closer to one represents greater interconnectivity among nodes within the social network; a value closer to zero represents little interconnectivity. How quickly information travels through a social network is, in part, a function of the interconnectivity among nodes in the social.

In-degree centralization is used to identify opinion leaders within the social network. The measure is calculated by comparing the in-degree centrality values (the number of incoming ties) for each node within the social network. Highly centralized social networks exhibit a hierarchical structure where one or two nodes have high in-degree centrality values. In contrast, nodes in distributed social networks have somewhat equivalent measures of in-degree centrality (Borgatti et al., 2013).

Core-periphery is a measure of how the nodes are distributed, that is, positioned within the social network structure. It is calculated by measuring the structural equivalence (position) of the nodes in the center of the social network and nodes at the edge of the social network (Borgatti et al., 2013). A social network with a high core value suggests an inwardly focused organization with little outside influence whereas a social network with a high periphery value suggests a network where there is little internal coordination within the unit. In an ideal social network, the core and periphery values should be somewhat equivalent, suggesting attention to both internal and external activities (Emery & Trist, 1965).

Average path length is a measure of the average of the shortest distance between all of the nodes in the social network. A small value for average path length suggests a dense, that is, interconnected, social network while a large value for average path length suggests a social network in which many of the nodes do not have ties to each other (Borgatti et al., 2013).

Diameter is a measure of the longest distance between two nodes within the social network. Information travels more slowly in social networks where the diameter is large because of the greater distance and number of ties that have to be traversed in order to reach the destination node (Borgatti et al., 2013).

Together, these measures, density, in-degree centralization, core-periphery, average path length, and diameter provide an understanding of the communication patterns, that is, the interconnectivity among nodes and nodes' positions within the social network. Node interconnectivity and position within the social network influence how quickly information travels through the social network.

Unit values for density, in-degree centralization, core-periphery, average path length, and diameter were calculated by the software, much like average or standard deviation is calculated within a statistical package. The calculated values were entered into a designated SPSS dataset for model testing.

This section described the processes to transform REDCap data into a format compatible with UCINet, software for social network analysis. Modifications were made to variable names (column headings), and rows were reordered to match the sequence of column headings. Once data were imported into UCINet, additional steps were required to dichotomize the values in preparation for analysis.

Data preparation: Communication and relationship quality. Calculation and aggregation of communication quality and relationship quality measures (Stage 2) used statistical methods of analysis. This section describes the processes required to transform individuals' responses to group level variables. Communication openness, accuracy, and timeliness were only measured on the hospital unit. Relationship quality data included the hospital responses as well as the responses from the post-acute care environments. This section also describes the processes of integrating home care and long-term care staff data into acute care, calculating variables, and aggregating the data to the unit level score.

Responses from the home care agencies and long-term care agencies were integrated into the hospital unit(s)' data set. Relationship quality responses from the home care agency were aligned with the hospital unit's responses to home care, similarly, the long-term care facilities were aligned with the hospital unit's response to the long-term care facility. If the hospital had more than one unit, responses from the post-acute settings were appended to the responses of the appropriate unit. Next, the Excel worksheet containing both the acute and post-acute data was imported into an SPSS dataset.

Before model analysis could begin, responses to four communication openness items and three relationship quality items were re-coded according to instructions by the scales' author. Next, individual scores for each subscale were calculated. At least 66% of the items in the scale required a valid response in order to calculate a value for the scale at the individual level. Unit subscale values were calculated as the average of the calculated individual subscale scores. Unit level scores were entered into an SPSS dataset for model testing.

This section described how communication quality, relationship quality, and demographic data from REDCap were imported into a single SPSS dataset. Individual scores

within each constellation (hospital unit, home care agency, and long-term care facility) were averaged to derive a unit score for each of the subscales. Reliability and consistency testing for the Stage 2 data are described in the next section.

Reliability. Scores for communication quality (openness, accuracy, and timeliness) and relationship quality scores were tested for reliability at the individual and unit levels. Cronbach's Alpha was used to assess the reliability of individual responses. Two measures, rwg(j) and ICC(1), were used to measure separate aspects of group level reliability among all participants, since group membership can influence individuals' agreement (LeBreton & Senter, 2007).

Rwg(j) is a measure of consensus among raters within the group, where j represents the number of items in the scale. There is no criterion of acceptance for this measure. Values for this measure can range from 0, demonstrating no consensus among respondents, to 1, demonstrating complete consensus among respondents. In this study, rwg(j) was used to measure consensus across roles, communication quality and care setting, relationship quality, in Stage 2.

Intraclass correlation coefficient represents the ratio of within-group agreement of participants in a group to between-group agreement among groups. Results from a one-way analysis of variance are used to calculate the ICC(1) Intraclass Correlation Coefficient, version 1, is used to compensate for differences in sample size. The acceptance criterion is between .05 and .20. In this study, ICC(1) was used to measure differences in agreement across roles, communication quality scale, and care settings, relationship quality scale, in Stage 2.

Evidence-based practice adherence. Adherence to the three evidence-based tasks (risk assessment, medication reconciliation, and post-discharge communication (Stage 3) were measured as separate, dichotomous variables in which a value of 1 represented a documented task. The unit adherence rate for each task was calculated as the number of times the task was

documented among discharged patients (numerator) over the number of patients discharged from the unit during the data collection period (denominator). Data for these calculations were obtained from the institutions' information systems. Unit level scores were entered into a designated SPSS dataset for model testing.

Specific Aims and Research Questions

This section describes the analytical methods used to answer each of the specific aims and corresponding research questions. For each specific aim, there is a brief description of the analysis that was used to answer the research questions listed under each specific aim.

Aim 1: Explore the impact of communication patterns (Stage 1) on communication quality (Stage 2).

1.1. What is the impact of density on communication openness, accuracy, and timeliness?

1.2. What is the impact of in-degree centralization on communication openness, accuracy, and timeliness?

1.3. What is the impact of core-periphery on communication openness, accuracy, and timeliness?

1.4. What is the impact of average path length on communication openness, accuracy, and timeliness?

1.5. What is the impact of diameter on communication openness, accuracy, and timeliness?

Social network data do not follow patterns of normal distribution. Spearman Rho was used to correlate measures of the social network for communication patterns (Stage 1) with measures of communication quality (Stage 2).

Aim 2: Explore the impact of communication patterns (Stage 1) on relationship quality (Stage 2).

2.1. What is the impact of density on relationship quality?

2.2. What is the impact of in-degree centralization on relationship quality?

2.3. What is the impact of core-periphery on relationship quality?

2.4. What is the impact of average path length on relationship quality?

2.5. What is the impact of diameter on relationship quality?

Spearman Rho was used to correlate measures of the social network for communication patterns (Stage 1) with measures of relationship quality (Stage 2).

Aim 3: Explore the impact of communication patterns on adherence to EBP.

3.1. What is the impact of density on rate of risk assessment, rate of medication reconciliation, and rate of discharge summary rate?

3.2. What is the impact of in-degree centralization on risk assessment, medication reconciliation, and discharge summary rate?

3.3. What is the impact of core-periphery on risk assessment, medication reconciliation, and discharge summary rate?

3.4. What is the impact of average path length on risk assessment, medication reconciliation, and discharge summary rate?

3.5. What is the impact of diameter on risk assessment, medication reconciliation, and discharge summary rate?

Spearman Rho was used to correlate measures of the social network for communication patterns (Stage 1) with the rate of adherence for each evidence-based transitional care task (Stage 3).

Aim 4: Explore the impact of communication patterns on adherence to EBP.

4.1. What is the impact of openness on rate of risk assessment, rate of medication reconciliation, and rate of discharge summary rate?

4.2. What is the impact of accuracy on risk assessment, medication reconciliation, and discharge summary rate?

4.3. What is the impact of timeliness on risk assessment, medication reconciliation, and discharge summary rate?

Spearman Rho was used to correlate measures of communication quality (Stage 2) with the rate of adherence for each evidence-based transitional care task (Stage 3).

Aim 5: What is the total effect of significant communication pattern variables and communication quality on EBP adherence?

5.1. Does communication quality serve as a mediator between communication patterns and EBP adherence?

5.2. What is the total effect of communication pattern on EBP adherence?

Hierarchical regression was the statistical procedure of choice to answer this question; subsequent issues in using regression for this study are discussed in Chapters 4 and 5.

Summary

The goal of this study was to explore the impact of communication patterns (Stage 1) within the adult medical-surgical units on communication quality (Stage 2), relationship quality (Stage 2) between the acute care and post-acute care environments, and adherence to three evidence-based transitional care activities (Stage 3). Nursing (RN, LPN, CNA) and discharge planning staff from 13 adult medical-surgical units and staff from six home care agencies and seven long-term care facilities participated. Social network analysis was used to measure the communication patterns, that is, the communication dyads on the unit pertaining to patient care

and patient discharge. Non-parametric correlations were used to analyze the relationships between the constructs in the model. Specifically, the social network variables obtained from the communication patterns data (Stage 1) were correlated with the communication quality (Stage 2) and relationship quality (Stage 2) variables. Social network variables were also correlated with the rate of adherence for the three evidence-based transitions of care tasks, risk assessment, medication reconciliation, and discharge summary. Chapter 4 contains the results of this analysis.

CHAPTER 4. RESULTS

The goal of this research was to explore the influence of nursing (RN, LPN, CNA) and discharge planning staff s' communication patterns on communication quality, relationship quality, and adherence to evidence-based transitional care tasks through the lens of social network analysis. The chapter begins with a description of the setting, sample, and participants (including their demographic characteristics), followed by reliability testing for communication and relationship quality scales (Stage 2), and the descriptive statistics for each stage in the conceptual model. The chapter concludes with the results of the model testing.

Setting, Sample, and Participants

This section provides a review of the setting, sample, and participants for this study. Changes in the analysis plan following preliminary data analysis are described as well.

Setting. The study was conducted in seven hospitals, six home care agencies (two hospitals used the same agency), and seven long-term care facilities in Maine. Four hospitals were members of a local health system and the remaining hospitals were affiliated with the health system, but were not members (see Table 6).

Sample. The research sample was comprised of 13 adult medical-surgical units in the seven hospitals. Each hospital had between one to three participating units (see Table 6).

Participation rates for each of the hospital units and their corresponding home care and nursing home facilities are provided (see Table 6). Five of the 13 hospital units achieved a participation rate of 50% or more of eligible staff (units 3.1, 4.1, 6.1, 6.2, 7.1). Six hospital units had participation rates between 30% and 50% (units 1.1, 1.2, 1.3, 2.1, 2.2, 5.1). Participation rates for two units (5.2 and 5.3) were under 30% and considered too low to assure a representative sample; these units were removed from subsequent analysis.

Table 6

Participation Rates by Site

Hospital (affiliation)	Unit	Hospital	Home Care Agency	Long-term Care Facility
1 (Affiliate)	1.1	15 (33%)	4 (80%)	3 (19%)
	1.2	27 (37%)		
	1.3	35 (46%)		
2 (Member)	2.1	13 (33%)	2 (67%)	3 (43%)
	2.2	15 (42%)		
3 (Member)	3.1	24 (67%)	9 (60%)	12 (92%)
4 (Member)	4.1	38 (54%)	2 (100%)	14 (93%)
5 (Member)	5.1*	10 (40%)	2* (33%)	3* (60%)
	5.2*	6 (19%)		
	5.3*	11 (21%)		
6 (Affiliate)	6.1	25(78%)	1 (50%)	9 (38%)
	6.2	17 (53%)		
7 (Affiliate)	7.1	70 (67%)	4 (100%)	1 (25%)

Note. *Removed from further analysis

Participating hospital units were selected by the investigator's primary contact within each hospital. After data collection, the investigator learned that unit 5.1 was a special care unit which did not meet the selection criteria. This unit also was removed from further analysis. Ten

units were included in the final sample for analysis; the aggregate participation rate among these remaining units was 50%.

Six home care agencies and seven long-term care facilities were included in the original sample to explore the perceptions of the working relationships between acute and post-acute staff (relationship quality Stage 2). One home care agency was used by two hospitals. Home care agencies and long-term care facilities were identified by the CNO or unit nurse manager as facilities where a majority of adult medical-surgical patients from their hospital were discharged. Participation rates among home care agency staff ranged from 33% to 100%; participation rates from long-term care facilities ranged from 19% to 93% (see Table 6). Home care and long-term care facilities associated with the hospital units that were dropped from analysis also were removed from further analysis. The final sample included five home care agencies and six long-term care facilities. Obtaining high participation among post-acute settings was less important since only a small number of staff from each organization were identified to participate in the survey and communication patterns within these settings were not analyzed.

Participants (Hospital staff). Participants from the adult medical-surgical units were comprised of nursing (RN, LPN, CNA) and discharge planning staff who had worked at least 40% over the previous 30 days. Persons having major responsibility for discharge planning were registered nurses or social workers and had titles including care coordinator, case manager, and discharge planner; they are referred to as discharge planners or discharge planning staff in this study. Among the 273 respondents, 163 (60%) were staff nurses, 21 (8%) were discharge planners, 15 (5%) were nursing or care coordination supervisors, and 74 (27%) were CNAs (see Table 7). Response rates from staff nurses on the day shift ranged from 9% to 32% while response rates from night shift staff nurses ranged from 8% to25%. Education and other

demographic variables are analyzed by role in Table 7. A breakdown of respondents by role and shift is provided in Appendix F.

Table 7

Unit Demographics

Variable	Selection	Staff Nurse	Discharge Planner	Supervisor	CNA /NUA
Education		N = 163	N = 21	N = 14	N = 68
	Diploma	10 (6.1%)	2 (9.5%)	1 (7.1%)	51 (75.0%)
	Associates	86 (52.8%)	4 (19.0%)	4 (28.6%)	3 (4.4%)
	Baccalaureate	63 (39.0%)	12 (57.0%)	8 (57.1%)	2 (3.0%)
	Master's	4 (2.5%)	3 (14.3%)	1 (7.1%)	0
	Doctorate	0	0	0	0
	Prefer not to say	0	0	0	12 (17.6%)
Shift		N = 164	N = 21	N = 13	N = 72
	Day	85 (51.8%)	21 (100%)	9 (69.2%)	37 (51.4%)
	Night	79 (48.2%)	0	4 (30.8%)	35 (48.6%)
Prof Tenure		N = 164	N = 20	N = 15	N = 72
	Less than 1 year	12 (7.3%)	1 (4.8%)	0	6 (8.3%)
	1-5 years	63 (38.4%)	1 (4.8%)	1 (6.7%)	27 (37.5%)
	6-15 years	37 (22.6%)	6 (28.6%)	9 (60.0%)	20 (27.8%)
	16+ years	52 (31.7%)	13 (61.9%)	5 (33.3%)	19 (26.4%)
Org Tenure		N = 161	N = 20	N = 14	N = 74
	Less than 1 year	19 (11.8%)	0	0	10 (13.5%)
	1-5 years	60 (37.3%)	6 (30.0%)	2 (14.3%)	34 (45.9%)
	6-15 years	53 (32.9%)	4 (20.0%)	7 (50.0%)	21 (28.4%)
	16+ years	29 (18.0%)	10 (50.0%)	5 (35.7%)	9 (12.2%)

Table 7 *Continued*

Variable	Selection	Staff Nurse	Discharge Planner	Supervisor	CNA /NUA
Full/Part Time		N = 163	N = 21	N = 14	N = 74
	Full-time	151 (92.6%)	19 (90.5%)	13 (92.9%)	67 (90.5%)
	Part-time	12 (7.4%)	2 (9.5%)	1 (7.1%)	7 (9.5%)
Org Participation		N = 159	N = 20	N = 15	N = 71
	None	64 (40.3%)	1 (5%)	1 (6.7%)	51 (71.8%)
	Within 1-3 years	82 (51.6%)	14 (70%)	13 (86.7%)	16 (22.5%)
	More than 3 years	13 (8.2%)	5 (25%)	1 (6.7%)	4 5.6%)
Prof. Participation*		N = 166	N = 21	N = 16	N = 76
	Non-member	61 (36.7%)	3 (14.3%)	5 (31.3%)	40 (52.6%)
	Member	19 (11.4%)	5 (23.8%)	1 (6.3%)	3 (3.9%)
	Read journal	60 (36.1%)	10 (47.6%)	7 (43.8%)	11 (14.5%)
	Attend meetings	44 (26.5%)	14 (66%)	1 (6.3%)	19 (25%)

Note. * Could select more than one item

Staff nurses. A total of 163 staff nurses completed the survey. Eighty-eight percent responded to all items. A majority of the staff nurses were prepared at the associate degree level (52.8%) followed by baccalaureate preparation (39%). Staff nurses were almost equally divided according to day and night shift schedules. Thirty-eight percent of the nurses had been a staff nurse between one and five years; 32% had been a staff nurse for at least 16 years; 7% of the nurses had been a staff nurse for less than a year. Thirty-seven percent of the staff nurses had been employed by the same hospital between one and five years, and 33% had worked there between six and 15 years. Ninety-two percent of staff nurses worked full time. A little over half

(52%) of the staff nurses had participated in a hospital-wide committee between one and three years ago. Over half of the staff nurses reported that they had some level of engagement with their professional association or organization, such as the State Nurses Association, including reading journals (36%) and attending meetings (26%).

Discharge planners. A total of 21 discharge planners completed the survey. Ninety percent responded to all items on the survey. Over 50% of discharge planners had a baccalaureate degree and 14% were master's prepared (N = 21). All participants worked days (N = 21). Nearly two thirds of respondents (62%) had been in their profession for at least 16 years, and 29% had been in their profession between six and 15 years (N = 20). Fifty percent had been employed by the same hospital for at least 16 years (N = 20). Most discharge planners (90%) worked full time (N = 21). Seventy percent had participated in a hospital-wide committee between one and three years ago (N = 20). Discharge planners reported some level of engagement with their professional organization such as reading journals (48%) and attending meetings (66%).

Supervisors. A total of 15 supervisors completed the survey; 73% responded to all items on the survey. Over 50% of responding supervisors had a baccalaureate degree and 7% were master's prepared (N = 14). Sixty-nine percent worked days (N = 13). Over half (60%) had been a supervisor between six and 15 years, and 33% had been a supervisor for at least 16 years (N = 15). Fifty percent of responding supervisors had worked in the same hospital for between six and 15 years; 36% had worked there for at least 16 years (N = 14). Almost all supervisors (93%) worked full-time (N = 14). Eighty-seven percent had participated in a hospital-wide committee between one and three years ago (N = 15). Supervisors reported some level of engagement with their professional organization such as reading journals (44%) and attending meetings (6%).

Certified nursing assistants. A total of 74 CNAs completed the survey; 74% responded to all items on the survey. To work in Maine, a CNA has to complete an approved training program and pass a competency test; most of the responding CNAs responded that they had completed such training, referred to as *diploma* in Table 7. There was a fairly even split between CNAs working days and evenings. Over one third (37%) had been a CNA between one and five years; 26% had been a CNA for at least 16 years (N = 72). Forty-six percent had been employed by the same hospital between one and five years, and 28% had worked there between six and 15 years (N = 74). Most CNAs (90%) worked full-time (N = 74). Nearly one quarter (22%) had participated in a hospital-wide committee between one and three years ago (N = 71). A few CNAs reported some level of engagement with their professional organization such as reading journals (14%) and attending meetings (25%). Participants could select more than one response to this item (N = 76).

Participants (home care and long-term care staff). Post-acute setting participants were those employees who engaged in regular communication with the hospital unit. Among the 66 participants, 46 (70%) were nurses, nine (14%) were discharge planners, and 11 (17%) were supervisors (see Table 8).

Table 8
Post-Acute Demographics

Variable	Selection	Nurse	Discharge Planner	Supervisor
Education		N = 46	N = 9	N = 11
	Diploma	12 (26.1%)	1 (11.1%)	
	Associates	18 (39.1%)	3 (33.3%)	6 (54.5%)
	Baccalaureate	15 (32.6%)	4 (44.4%)	2 (18.2%)
	Master's	1 (2.2%)		3 (27.3%)
	Doctorate			

Table 8 *Continued*

Variable	Selection	Nurse	Discharge Planner	Supervisor
	Prefer not to say			
Shift		N = 46	N = 9	N = 10
	Day	36 (81.8%)	9 (100%)	8 (72.7%)
	Night	8 (18.2%)	0	2 (18.2%)
Professional Tenure		N = 46	N = 9	N = 11
	Less than 1 year	3 (6.5%)	0	0
	1-5 years	9 (19.6%)	1 (11.1%)	1 (9.1%)
	6-15 years	7 (15.2%)	2 (22.2%)	4 (36.4%)
	16+ years	27 (58.7%)	6 (66.7%)	6 (54.5%)
Organizational Tenure		N = 46	N = 9	N = 11
	Less than 1 year	6 (13.0%)	0	2 (18.2%)
	1-5 years	14 (30.4%)	3 (33.3%)	4 (36.4%)
	6-15 years	13 (28.3%)	2 (22.2%)	4 (36.4%)
	16+ years	13 (28.3%)	4 (44.4%)	1 (9.1%)
FT/PT		N = 46	N = 9	N = 11
	Full time	39 (84.8%)	8 (88.9%)	13 (92.9%)
	Part time	7 (15.2%)	1 (11.1%)	1 (7.1%)
Organizational Participation		N = 46	N = 9	N = 11
	None	18 (39.1%)	3 (33.3%)	4 (36.4%)
	Within 1-3 years	19 (41.3%)	5 (55.6%)	7 (63.6%)
	More than 3 years	9 (19.6%)	1 (11.1%)	0
Professional Participation*		N = 46	N = 9	N = 11
	Non-member	17 (37.0%)	3 (33.3%)	2 (18.2%)
	Member	7 (15.2%)	1 (11.1%)	1 (9.1%)
	Read journal	16 (34.8%)	2 (22.2%)	5 (45.5%)
	Attend meetings	8 (17.3%)	6 (66.6%)	7 (63.6%)

Note. * Could select more than one item

Nurses. Over one third (39%) of nurses in the post-acute settings held associates degrees and 33% held baccalaureate degrees; one nurse (2%) was master's prepared. More than half (59%) of participants were in their profession for more than 16 years, and over 50% had been in the same institution for at least six years. A majority of participants (41%) participated in institutional-wide committees between one and three years ago. About one third of participants did not engage in any professional organization while another third (35%) read the journals and 17% attended meetings.

Discharge planners. Over one third (33%) of discharge planners held associates degrees and 44% held baccalaureate degrees; there were no master's prepared discharge planners. Two thirds (67%) of participants were in their profession for more than 16 years; they had been in the same institution for at least six years (67%). A majority of participants (55%) had participated in institutional-wide committees between one and three years ago. Two thirds (66%) of participants attended meetings sponsored by their professional organization, 22% read journals, and 33% were not members of professional organizations.

Supervisors. Over half (55%) of discharge planners held associates degrees, 18% held baccalaureate degrees, and 27% of discharge planners were master's prepared. Half of the participants (55%) were in their role for more than 16 years and less than half (45%) had been in the same institution for at least six years. A majority of participants (64%) participated in institutional-wide committees between one and three years ago. Almost two thirds (64%) of participants attended meetings sponsored by their professional organizations, 46% read journals, and 18% were not members of their professional organizations.

This section described the setting, sample, and participants for this study. Two units and their corresponding post-acute organizations were removed from the analysis because of low participation rates. Another unit from the same hospital was also removed from the analysis because it did not meet the inclusion criteria. The aggregate response rate across the sample was 50% among the 10 units, 76% among the five home care agencies, and 52% among the six long-term care facilities.

Instruments

The Stage 1 construct, communication patterns, was measured with an instrument comprised of two investigator-designed items. Measures for the Stage 2 constructs, communication quality and relationship quality, were adapted from the ICU Nurse-Physician Questionnaire (Shortell et al., 1991). Measures of adherence to the transitional care tasks (Stage 3) were based on documentation of these tasks in the hospitals' information systems.

Hospital staff received a questionnaire comprised of all the instruments (communication patterns, communication quality, and relationship quality). Post-acute care staff received a questionnaire including the communication pattern and relationship quality instruments.

Relationship quality was measured between the hospital and the home care agency staff as well as between the hospital and the long-term care facility staff. Due to the small sample size and low participation rates from the post-acute settings, acute care and post-acute care responses were aggregated for further analysis and reported by post-acute setting.

Reliability. Model testing was conducted at the unit level, meaning that the sample for analysis was comprised of individual data aggregated to a single unit-level response. Communication pattern data (Stage 1), collected and analyzed using social network methods,

were not tested for reliability as these were measures of relationships between respondents and would vary by both sample and question (Borgatti et al., 2013; Prell, 2012).

Measures for Stage 2 data (communication quality and relationship quality) were evaluated for internal consistency reliability first at the individual level and then at the aggregate level. Internal consistency reliability for individual response data was measured using Cronbach's alpha. The acceptance criterion for Cronbach's alpha is usually .60 for new instruments and .80 for established instruments; however, since this was a new application of an established instrument, the acceptance criterion was .70 (J. Verran, personal communication, January 19, 2015).

Tests of reliability, $r_{wg(j)}$ and intraclass correlation (ICC), were conducted to support the aggregation of individual responses to the unit level. $r_{wg(j)}$ is a measure of agreement among participants within the group (unit). Intra class correlation is the ratio of within- and between-group variances.

Cronbach's alpha: Communication quality. The Cronbach's alpha for the three communication quality subscales measured as a whole, without regard to unit, met the acceptance criterion. Reliability estimates were .73 for timeliness, .79 for openness, and .77 for accuracy across the hospital units.

Cronbach's alpha: Relationship quality. A single measure of relationship quality was collected for hospital (excluding CNAs) and home care staff and for hospital and nursing home staff. The alpha for relationship quality for hospital and home care staff was .82 and .78 for hospital and long-term care staff.

rwg(j): Communication quality. The $r_{wg(3)}$ values for communication openness among all units ranged from .65 to .92; $r_{wg(4)}$values for communication accuracy across all units ranged

from .61 to .90; and $r_{wg(3)}$values for communication timeliness across all units ranged from .79 to .95. Communication quality $r_{wg(j)}$ values are shown for each unit as well as an average for all units (Table 9).

Table 9

Reliability Testing: Communication Quality

Unit	Openness $r_{wg(3)}$	Accuracy $r_{wg(4)}$	Timeliness $r_{wg(3)}$
Mean of all units	0.87	0.78	0.89
1.1	0.96	0.80	0.91
1.2	0.89	0.73	0.93
1.3	0.90	0.75	0.87
2.1	0.91	0.81	0.95
2.2	0.95	0.82	0.92
3.1	0.65	0.61	0.79
4.1	0.92	0.73	0.93
6.1	0.70	0.81	0.79
6.2	0.92	0.90	0.92
7.1	0.89	0.82	0.92

Note: N = 10

rwg(4): Relationship quality. $r_{wg(4)}$ was measured for relationship quality between the hospital staff and home care staff as well as between the hospital staff and long-term care staff for each unit. The $r_{wg(4)}$ values for relationship quality for home care for all units ranged from .73 to .94; $r_{wg(4)}$ values for relationship quality for long-term care for all units ranged from .85 to .95.

Relationship quality $r_{wg(j)}$ values are shown for each unit as well as an average for all units (Table 10).

Table 10

Reliability Testing: Relationship Quality

	Home Care	Long-term Care
Unit	$r_{wg(4)}$	$r_{wg(4)}$
Mean for all units	0.87	0.91
1.1	0.73	0.85
1.2	0.80	0.94
1.3	0.86	0.95
2.1	0.93	0.91
2.2	0.94	0.89
3.1	0.82	0.85
4.1	0.91	0.91
6.1	0.90	0.90
6.2	0.93	0.93
7.1	0.91	0.94

Note. N = 10

Intraclass correlation: Communication quality. Values from a one way analysis of variance on unit, were used to calculate the ICC(1) for the communication quality scales openness, accuracy, and timeliness. The ICC(1) values for openness (.05) and timeliness (.02) met the criterion, while the ICC(1) value for accuracy did not, which was likely due to a lack of

variability between units (groups) since the r_{wg} for accuracy indicated within group agreement for all units.

Intraclass correlation: Relationship quality. Values from a one way analysis of variance on setting were used to calculate the ICC(1) for relationship quality between hospital and home care staff and between hospital and long-term care staff. The ICC(1) value for long-term care (.04) met the acceptance criterion, however, the ICC(1) value for home care (.0) did not, which was most likely due to insufficient variance in agreement.

Consistency reliability and aggregate reliability were measured for communication quality and relationship quality scales using Cronbach's alpha, $r_{wg(j)}$ and ICC(1). All of the scales met the acceptance criterion for Cronbach's alpha and rwg(j), but not for ICC(1).Communication timeliness and relationship quality for home care did not meet the ICC(1) acceptance criterion. The following section describes changes to the analysis plan as a result of data collection and preliminary data analysis.

Changes in the Analysis Plan

Low response rates and the results of psychometric evaluation of the instruments influenced subsequent description and analysis of concepts and relationships in the theoretical model. There were two substantive changes in the analysis plan. First, analysis of communication patterns was reduced from analysis of two distinct communication patterns to analysis of a single communication pattern, patient care. Second, the number of social network variables that were planned to be analyzed as indicators of communication patterns was reduced from five to two and a new communication pattern variable was added. An explanation of each of these changes follows.

Change in communication patterns measurement. Data were collected for two social networks representing communication for patient care and patient discharge. Inclusion criteria for each network were the same; although, patient discharge communication was more likely to occur between staff nurses working the day shift and discharge planning staff. The investigator hypothesized that patient care communication among all staff would inform patient discharge communication as communicated by staff nurses on the day shift. Low response rates among day shift nurses and discharge planning staff (See table 11 and Appendix F), combined with the exclusion of select non-unit based staff integral to patient discharge activities, resulted in a sparse network that was not representative of patient discharge communication patterns. For this reason, the social network representing patient discharge communication patterns was dropped from the analysis.

Table 11

Response Rates Day Shift Nurses and Discharge Planners

Unit	Surveys distributed to nursing staff	Participating Day Nurses	Response Rate Day Staff Nurses	Total Discharge Planners	Participating Discharge Planners
1.1	39	4	10%	3	2
1.2	66	6	9%	3	2
1.3	73	12	16%	2	1
2.1	36	4	11%	3	1
2.2	31	5	16%	3	3
3.1	31	6	19%	4	0
4.1	67	12	18%	3	1

Table 11 *Continued*

Unit	Surveys distributed to nursing staff	Participating Day Nurses	Response Rate Day Staff Nurses	Total Discharge Planners	Participating Discharge Planners
6.1	28	9	32%	2.5	2
6.2	28	7	25%	2.5	0
7.1	92	20	22%	11	9

Changes in social network variables. Five measures of the social network (density, in-degree centralization, core-periphery, average path length, and diameter) were included in the original analysis plan. These measures are calculated either by the number of nodes connected by ties, or by the distance between nodes as measured by the number of ties. Variables that are measured using the number of nodes connected by ties remain robust even with lower response rates. Density and in-degree centralization meet this criterion (Borgatti et al., 2006; Costenbader & Valente, 2003).

The three remaining measures (core-periphery, average path length, and diameter) represent the node's proximity to other nodes in the social network. Measures which are based on proximity as measured by number of ties between nodes become inaccurate when less than 50% of the individuals in the social network respond; this constraint is similar to the sample size requirements for some statistical testing. Since half of the units had participation rates less than 50%, it was necessary to drop the measures of core-periphery, average path length, and diameter from further analysis.

A new measure, fragmentation, was added to the analysis plan for the communication patterns construct. Fragmentation is a more specific measure of density; it is a measure of the

distribution of the interconnected nodes in the social network. The term is sometimes defined as *clumpiness*. In contrast, density is an overall measure of interconnectedness of the social network. High measures of fragmentation suggest a unit with a lot of small groups in which members communicate among themselves, but not with other groups. Low measures of fragmentation suggest a unit in which there is a high level of interconnectedness among the nodes.

This section described changes in the analysis plan for communication patterns. Social network analysis for patient discharge communication was dropped from the analysis plan due to low participation among day nurses and discharge planning staff, who have the most responsibility for patient discharge communication. Three variables (core-periphery, average path length, and diameter) were dropped from the analysis because of low participation rates on some units. A new variable, fragmentation, was added to the analysis plan.

Descriptions of Concepts in the Theoretical Model

This section provides additional detail for each concept. The concepts are presented in the order of the model.

Communication patterns for patient care. This social network reflected who talks to whom on the unit regarding patient care. The social network variables, density, fragmentation, and in-degree centralization are measures of interconnectedness among nodes and the direction of the communication flows. A more detailed description of these variables follows.

Density. Density is a measure of interconnectedness among nodes in the social network. In this study, density reflected who talks to whom about patient care and was calculated as a rate. The denominator is the number of all of the possible ties within the social network (unit) and the numerator is the number of the actual recorded ties within the social network (Borgatti et al.,

2013). Values for density can range from zero (no ties) to one (where every node has a tie to every other node in the social network). The evaluation of what is considered realistic for high density is influenced by the size of the network. That is, the likelihood of a social network comprised of 1,000 nodes (individuals) is unlikely to have a density of .75 (75% of all possible ties are present), where a social network comprised of 20 nodes could easily have a density of .75. Positive or negative interpretations of density are determined by the question posed. For example, if the question is, *With whom do you share best practices when caring for patients with c-difficile?* one would hope that the density value is high. If the question is, *With whom have you shared your username and password for the hospital's information systems?* one would hope that the density value is extremely low. Values for density among the 10 adult medical-surgical units in the sample ranged from .19 to .53 (see Table 12).

Table 12

Communication Pattern Variables

Unit	Participation Rate	Density	Fragmentation	In-degree Centralization
1.1	33%	.23	.69	.07
1.2	37%	.33	.64	.36
1.3	46%	.27	.59	.10
2.1	33%	.19	.69	.10
2.2	42%	.24	.67	.08
3.1	67%	.43	.46	.12
4.1	54%	.37	.51	.10
6.1	78%	.53	.34	.15
6.2	53%	.40	.50	.12

Table 12 *Continued*

Unit	Participation Rate	Density	Fragmentation	In-degree Centralization
7.1	67%	.43	.38	.15

Fragmentation. Fragmentation is also a measure of connectedness within the social network. While density is a measure of ties within the entire social network, fragmentation is a measure of the lack of ties between groups or cliques (Borgatti et al., 2013). The value for fragmentation is usually close to the inverse of the value for density. Values for fragmentation can range from zero, where every node has a tie to every other node in the social network, to one, where none of the nodes in the social network have ties to another node. When fragmentation is low, there are few isolated groups and consequently high density; when fragmentation is high there are many isolated nodes or groups and consequently low density. In select cases, such as communication openness, fragmentation is useful to describe the relationships within small groups. In this study, fragmentation values ranged from .34 to .69. That is, some adult medical-surgical units reported as much as 69% of staff were members of small groups that did not communicate with other groups. The range in fragmentation values may have been due to the fact that participants included nurses and CNAs from both day and night shift as well as the discharge planners, each of which could be considered their own group or social network. CNAs, no matter which shift, do not talk with discharge planners, and nurses on the night shift do not talk with discharge planners, all of which could be considered examples of fragmentation (see Table 12).

In-degree centralization. In-degree centralization is an aggregate measure of in-degree centrality at the unit level. In-degree centrality is the number of ties into each node in the social

network (unit). This measure is an indicator of the communication pattern structure on the unit. When the majority of incoming ties in the social network are associated with a few nodes, a hierarchical or centralized structure for communication patterns can be inferred. When the incoming ties in the social network are distributed relatively equally, a decentralized structure for communication patterns can be inferred. In this study, values for in-degree centralization ranged from .07 to .36 (see Table 12). For example, a unit where all communication to and from external sources is filtered through the nurse manager is considered to have high in-degree centralization, since communication goes through a single node. In contrast, a shared office of nurse practitioners may be more decentralized and would have a lower in-degree centralization value.

This section described the social network analysis for communication patterns regarding patient care among nursing (RN, LPN, CNA) and discharge planning staff on the adult medical-surgical units. Patient discharge communication patterns were dropped from further analysis because of low representation among registered nurses on the day shift and discharge planning staff, those who have primarily responsibility for patient discharge communication. Three communication pattern variables were removed because of low participation rates among some units. Another measure of the social network, fragmentation, was added. The results indicate that there was low in-degree centralization, meaning that the unit structures in the participating units were not hierarchical. Fragmentation values range from .34 to as much as .69 which may be due to the fact that nursing (RN, LPN, and CNA) and discharge planning staff on both day and night shift were surveyed. These groups represent distinct sub groupings within the larger unit level social network. Communication may not be successful between the smaller social networks.

Communication quality (Stage 2). Communication quality was measured using three scales (openness, accuracy, and timeliness) which were adapted from the ICU Nurse-Physician Questionnaire (Shortell et al., 1991). These scales have been adapted for use in other environments including the emergency department (H. E. Hansen et al., 1999) and post-acute care (Temkin-Greener et al., 2004). Responses to the scale items used a 5-point Likert scale ranging from 1, strongly disagree, to 5, strongly agree.

Openness. The openness scale, comprised of three items, measured the participants' perception of being able to say what they mean. Mean scores for each unit ranged from 4.03 to 4.74. Standard deviations for each unit ranged from 0.37 to 1.06 (see Table 13). These scores reflected moderate to high openness on the units.

Table 13

Communication Quality Descriptive Statistics

	Openness			Accuracy			Timeliness		
Unit	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
1.1	14	4.74	0.37	14	3.30	0.54	14	4.19	0.50
1.2	27	4.25	0.60	27	3.38	0.93	27	4.19	0.54
1.3	35	4.49	0.54	35	3.08	0.84	35	3.87	0.42
2.1	13	4.31	0.54	13	3.08	0.84	13	3.87	0.42
2.2	15	4.47	0.47	15	3.32	0.86	15	3.89	0.54
3.1	22	4.20	1.06	22	3.73	0.90	23	3.91	0.74
4.1	37	4.49	0.54	37	3.54	0.85	37	4.29	0.52
6.1	25	4.03	0.94	25	3.46	0.81	25	3.92	0.88
6.2	17	4.12	0.50	17	3.06	0.50	17	3.96	0.47

Table 13 *Continued*

	Openness			Accuracy			Timeliness		
Unit	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
7.1	69	4.31	0.55	68	3.35	0.74	69	4.00	0.48

Accuracy. The accuracy scale, comprised of four items, measured the participants' belief in the consistent accuracy of the information conveyed to them by other members of the nursing (RN, LPN, CNA) and discharge planning staffs (Shortell et al., 1991). Mean scores for each unit ranged from 3.06 to 3.73. Standard deviations for each unit ranged from 0.50 to 0.93 (see Table 13). In contrast to openness where scores reflected moderate to high agreement, the scores for accuracy were lower reflecting a neutral (neither agree nor disagree) perception of consistent communication accuracy on the units overall.

Timeliness. The timeliness scale, comprised of three items, measured the degree to which patient care information was relayed promptly to the people who needed to be informed (Shortell et al., 1991). Mean scores for each unit ranged from 3.87 to 4.29. Standard deviations for each unit ranged from 0.42 to 0.88 (see Table 13). Timeliness scores were between the unit scores for openness and accuracy. These scores ranged from neutral to moderate agreement that patient information was relayed promptly. Within-unit differences in scores were less than one standard deviation.

Relationship quality (Stage 2). Relationship quality represented the perceptions of the working relationship between the adult medical-surgical unit staff and the post-acute care staff. That is, the perceptions of the working relationship between the unit staff and the home care staff and the working relationship between the unit staff and the long-term care staff. The relationship

quality scale was adapted from the ICU Nurse-Physician Questionnaire (Shortell et al., 1991) and was comprised of four items. Responses to the scale items used a 5-point Likert scale ranging from 1, strongly disagree, to 5, strongly agree. Both the hospital and the post-acute care staff answered items regarding relationship quality. Hospital staff responded to these questions twice, once in relation to home care agency staff and again in relation to the long-term care facility staff. Post-acute care staff answered the questions once with regards to their working relationship with the hospital. Responses from the hospital and home care staff were combined as were the responses from hospital and the long-term care facility staff due to small samples from the post-acute care environments. Scores were reported under the post-acute care environment. High $r_{wg(4)}$ scores for relationship quality (.88 and .90) demonstrated strong levels of agreement between groups, thereby allowing the aggregation across care settings.

Home care agency. Home care relationship quality values reflected the responses from the hospital unit staff and the identified home care agency staff. Mean scores for each unit ranged from 3.27 to 3.96, indicating neutrality. The standard deviation ranged from 0.39 to 0.84 (see Table 14).

Long-term care facility. Long-term care relationship quality values reflected the responses from the hospital unit staff and the identified long-term care facility staff. Mean scores for each unit ranged from 3.19 to 3.51, indicating neutrality. The standard deviation ranged from 0.44 to 0.77 (see Table 14).

Relationship quality (Stage 2) reflected the perceptions of the working relationship between the hospital unit staff and the post-acute care organization's staff. Relationship quality scores for the long-term care facilities were lower than the relationship quality scores for the home care agencies for all units.

Table 14

Relationship Quality Descriptive Statistics

	Home Care Agency			Long-term Care Facility		
Unit	N	Mean	Standard Deviation	N	Mean	Standard Deviation
1.1	16	3.81	0.76	15	3.25	0.71
1.2	18	3.81	0.84	16	3.28	0.44
1.3	29	3.72	0.76	28	3.47	0.46
2.1	11	3.27	0.62	12	3.19	0.71
2.2	15	3.57	0.39	16	3.31	0.61
3.1	22	3.66	0.68	24	3.28	0.46
4.1	28	3.81	0.72	39	3.51	0.77
6.1	15	3.96	0.71	23	3.51	0.62
6.2	12	3.69	0.63	20	3.43	0.61
7.1	57	3.68	0.59	54	3.34	0.58

Evidence-based practice adherence. EBP adherence for three tasks (risk assessment, medication reconciliation, and discharge summery) was the terminal outcome in this study. The adult medical-surgical units' rates of adherence for these tasks were requested from the unit nurse manager or the CNO (see Table 15). These data were self-reported and likely obtained from the EMR; however, there was no reliability checking to confirm the reported rate. The investigator provided structured query-like language to the unit nurse manager or the CNO which could be used for communication with the hospitals' information services department. Two units (6.1 and 6.2) did not provide adherence rates for these tasks, despite frequent emails and phone calls to the hospital contact. Three units (2.1, 2.2, 3.1) reported 100% compliance for

all tasks. Adherence rates for risk assessment among the remaining five units ranged between 78% and 97%, medication reconciliation adherence rates ranged between 82% and 99%, and discharge summary adherence rates ranged from 46% to 95% (see Table 15).

Table 15

Evidence-based Practice Adherence Rates

Unit	Risk Assessment	Medication Reconciliation	Discharge Summary
1.1	79%	99%	67%
1.2	80%	99%	66%
1.3	78%	95%	55%
2.1	100%	100%	100%
2.2	100%	100%	100%
3.1	100%	100%	100%
4.1	97%	95%	95%
6.1 *			
6.2*			
7.1	82%	82%	46%

Note. * Missing data

This section provided unit level descriptive statistics for each of the instruments within each stage of the conceptual model. Communication patterns among nursing (RN, LPN, CNA) and discharge planning staff (Stage 1) were analyzed using social network methods. Communication quality variables, openness, accuracy, and timeliness (Stage 2) were measured only among hospital staff. Relational quality (Stage 2) was measured among the hospital staff and identified home care and long-term care staff. Adherence rates for the three evidence-based

transitional care tasks (Stage 3) were self-reported and ranged from as low as 46% to as high as 100%. The results of this analysis met the acceptance criteria to advance to model testing.

Model Testing

This section reports the results of model testing by each research aim. Correlations, specifically Spearman's rho, were used to test the relationships between concepts. Sample size did not allow for use of regression analysis. Non-parametric statistics were used because communication pattern data are dependent, measuring a relationship between nodes, and therefore do not have a normal distribution, a requirement of parametric statistics. Small sample size was another reason for using non-parametric statistics. The level of statistical significance was set at .10 due to the exploratory nature of the study.

Specific aim 1. The purpose of this aim was to explore the impact of communication patterns on communication quality. The aim was operationalized as correlations between the communication pattern variables, density, fragmentation, and in-degree centralization (Stage 1) and communication quality variables openness, accuracy and timeliness (Stage 2) (see Table 16).

Table 16

Correlation Stage 1 and Stage 2 (Communication Quality)

	Communication Quality		
Communication Pattern	Openness Rho (p)	Accuracy Rho (p)	Timeliness Rho (p)
Density	-.80 (.005)	.56 (.093)	.06 (.868)
Fragmentation	.72 (.018)	-.49 (.148)	-.08 (.828)
In-degree centralization	-.57 (.083)	.34 (.334)	.36 (.343)

Note. N = 10

Openness. All of the communication pattern variables were significantly associated with openness at $p < .10$. Density and in-degree centralization were negatively associated with openness ($r_s(10) = -.80$, $p = .005$) and ($r_s(10) = -.57$, $p = .083$) respectively. Fragmentation was positively association with openness ($r_s(10) = .72$, $p = .018$).

Accuracy. Only one communication pattern variable was significantly associated with accuracy. Density was significantly and positively associated with accuracy ($r_s(10) = .56$, $p = .09$). The association between accuracy and fragmentation was strong and negative but not significant ($r_s(10) = -.49$, $p = .148$). In-degree centralization was moderately correlated with accuracy; the relationship was not statistically significant.

Timeliness. There were no significant associations between the communication pattern variables and timeliness.

Specific aim 2. The purpose of this aim was to explore the impact of communication patterns on relationship quality. The aim was operationalized as correlations between the communication pattern variables (density, fragmentation, and in-degree centralization) (Stage 1) and relationship quality variables (home care and long-term care) (Stage 2) (see Table 17).

Table 17

Correlation Stage 1 and Stage 2 Relationship Quality

Communication Pattern	Home Care Rho (p)	Long-term Care Rho (p)
Density	.31 (.383)	.58 (.082)
Fragmentation	-.31 (.383)	-.66 (.038)
In-degree centralization	.12 (.750)	.13 (.713)

Note. N = 10

Home care. Two communication pattern variables were moderately correlated with home care perceptions of relationship quality. Density was positively, but not significantly associated with relationship quality ($r_s(10) = .31$, $p = .383$). Fragmentation were moderately, but not significantly, correlated in the negative direction with home care perceptions of relationship quality ($r_s(10) = -.31$, $p = .383$). In-degree centralization was not significantly associated with home care perceptions of relationship quality**.**

Long-term care. Two communication pattern variables were moderately to highly correlated with long-term care perceptions of relationship quality. Density was moderately and significantly associated with relationship quality for long-term care in the positive direction ($r_s(10) = .58$, $p = .082$). Fragmentation was highly and significantly associated with relationship quality for long-term care in the negative direction ($r_s(10) = -.66$, $p = .038$). In-degree centralization was not significantly associated with long-term care perceptions of relationship quality.

Specific aim 3. The purpose of this aim was to explore the impact of communication patterns on adherence to EBP. This aim was operationalized as correlations between the communication pattern variables density, fragmentation, and in-degree centralization (Stage 1) and adherence to three evidence-based transitions of care tasks, risk assessment, medication reconciliation, and discharge summary (Stage 3) (see Table 18).

Table 18

Correlation Stage 1 and Stage 3

	Risk Assessment Rho (p)	Medication Reconciliation Rho (p)	Discharge Summary Rho (p)
Density	.07(.863)	-.29 (.482)	-.24 (.560)
Fragmentation	.05 (.909)	.51 (.194)	.42 (.307)
In-degree centralization	-.10 (.818)	-.20 (.643)	-.44 (.276)

Note. N = 8

There were no statistically significant associations between the communication pattern variables and the EBP adherence variables. There was a substantial, but not significant, association between fragmentation and medication reconciliation ($r_s(8) = .51$, $p = .194$).

Specific aim 4. The purpose of this aim was to explore the impact of communication quality on adherence to EBP. This aim was operationalized as correlations between communication quality variables openness, accuracy, and timeliness (Stage 2) and EBP adherence variables risk assessment, medication reconciliation, and discharge summary (Stage 3) (see Table 19).

Table 19

Correlation Stage 2 (Communication Quality) and Stage 3

	Risk Assessment	Medication Reconciliation	Discharge Summary
Openness	-.47 (.244)	-.12 (.772)	-.20 (.641)
Accuracy	-.25 (.954)	-.17 (.684)	-.10 (.817)
Timeliness	-.86 (.006)	-.52 (.191)	-.74 (.037)

Note. N = 8

Risk assessment. Timeliness was significantly and negatively associated with risk assessment ($r_s(8) = -.86$, $p = .006$). Openness and accuracy also were negatively associated with risk assessment. Openness was moderately correlated with completion of risk assessment but not statistically significant. The correlation between accuracy and completion of risk assessment was low and not statistically significant.

Medication reconciliation. There were no significant associations between the communication pattern variables and medication reconciliation. The correlation between timeliness and medication reconciliation was moderate.

Discharge summary. Timeliness was significantly and negatively associated with discharge summary. ($r_s(8) = -.74$, $p = .037$). Openness and accuracy had low correlations with completion of the discharge summary. These relationships were not statistically significant.

Specific aim 5. The purpose of this aim was to explore the total effect of significant communication patterns and quality on EBP adherence. This aim was operationalized as a statistical regression among all of the significant variables from the previous correlations with EBP adherence as the dependent variable. However, due to the small sample size (eight units) and the number of significant correlations, it was not possible to conduct an analysis related to this aim.

Summary

This chapter described the results of data analysis including description of the sample, psychometric evaluation of the instruments at the individual and, when appropriate, at the aggregate level, description of each variable and model testing according to the research aims. In addition, changes in the analysis plan due to small sample size were explained.

The final sample was comprised of 10 adult medical-surgical units, five home care agencies, and six long-term care facilities. Unit participants were comprised of nursing (RN, LPN, CNA) and discharge planning staff. Participants from the home care and long-term care organizations included nurses and social workers.

Analysis of each concept in the model at the unit level showed that the units varied in their communication patterns. Communication quality was consistent across units with openness having the highest values followed by timeliness and then openness. Relationship quality was higher among home care staff than long-term care staff.

Key findings from model testing included significant relationships between communication patterns and communication quality openness and accuracy. Timeliness was significantly associated with risk assessment and discharge summery, but not with communication patterns.

Changes were made to the analysis plan as a result of lower than expected participation rates; some units were removed from the sample and some communication pattern variables could not be measured. Reliability of the communication quality and relationship quality measures was calculated at both individual and aggregate levels and achieved acceptable levels for further analysis at the unit level.

Results for each concept were described followed by the correlation results across stages in the model. Full model testing was not possible due to sample size limitations. The next chapter includes a discussion and application of these findings to nursing science as well as limitations and areas for future research.

CHAPTER 5. DISCUSSION

The purpose of this study was to explore the influence of nursing (RN, LPN, CNA) and discharge planning staffs' communication patterns on communication quality, relationship quality, and adherence to evidence-based transitional care activities. While there are many studies describing the factors that influence the use of evidence-based findings in practice, there has been little improvement in either the speed or consistency in which research findings are integrated into clinical practice over the past four decades (Squires, Hutchinson et al., 2011). The idea for this study came from EBP research findings which reported that nurses obtain answers to clinical questions from other nurses (Benner et al., 1997; Estabrooks et al., 2005; Ko, 2011; Pravikoff et al., 2005; Profetto-McGrath et al., 2007). To date, there has been little research on the influence of the social networks and communication quality on nursing staff's EBP adoption and adherence. This study was among the first to explore the impact of two constructs (communication patterns and communication quality) on adoption of and adherence to evidence-based transitional care activities using social network theory and analysis.

Study participants included nurses, discharge planners, supervisors, and CNAs from 10 hospital units in six hospitals, five home care agencies, and six long-term care facilities. The study focused on members of the nursing team in the hospital and post-acute providers (home care and skilled nursing facilities) with significant responsibility for transitional care activities. Certified nursing assistants were included in the study because, as full critical members of the nursing care team, they contribute to the performance of discharge activities as assigned an as supervised by licensed staff member. Data were collected via individual surveys and the responses were analyzed at the group level, consistent with social network analysis methods.

As a result of model testing, eight statistically significant associations and one association that trended towards significance were discovered. The majority of these associations were between Stage 1, communication patterns and Stage 2, communication quality and relationship quality, there were also two significant associations between the communication quality variable, timeliness, and two EBP adherence variables, risk assessment and discharge summary (Figure 4).

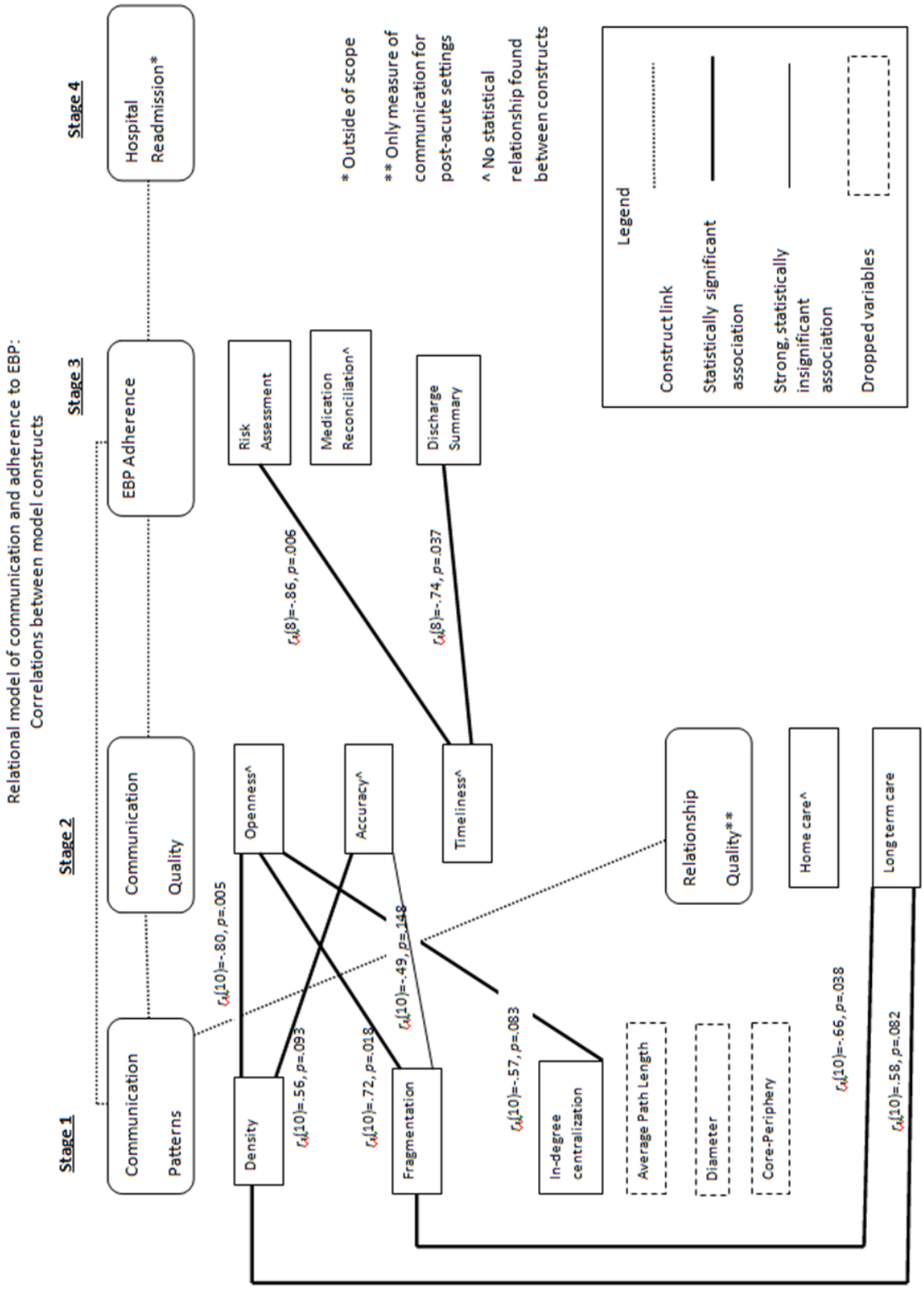

Figure 4. Relational Model of Communication and Adherence to EBP with Measures of Association

Three limitations impacted how this study was conducted and analyzed as well as how the findings could be interpreted. These limitations are described first in order to set the context for data interpretation, contributions to nursing theory and science, and future research.

Study Limitations

There were three major limitations in this study which impacted data analysis and how the findings were interpreted. The limitations addressed issues of (a) sampling, (b) response rate, and (c) the choice and measurement of the evidence-based tasks. Each limitation is discussed separately followed by a discussion of the combined effect of the limitations.

Sampling. Investigator-defined inclusion criteria and post-acute care leaders' interpretation of the participant inclusion criteria may have excluded relevant participants with regard to transitional care communication and activities. Investigator-defined inclusion criteria and post-acute care leaders' interpretation are described separately.

Investigator-defined inclusion criteria. Sampling criteria for hospital-based participants were used to establish the social network boundaries for both communication pattern concepts (patient care communication and patient discharge communication). The criteria were based on the composition of unit staff and input from unit managers. All nursing staff, including both day and night shifts, RNs, LPNs and CNAs, were eligible to participate if they met the inclusion criteria for number of hours worked over the previous 30 days, tenure in the organization, and could read and speak English. The same sampling criteria were used for both communication patterns since it was believed that the patient care communication would inform and be considered part of patient discharge communication.

In retrospect, using the same sampling criteria for both communication patterns was an important limitation in this study since it is likely that the social networks may well be different

for each type of communication. Low response rate on discharge planning communication precluded their comparison.

Although members of the nursing staff may be expected to communicate about patients, communication about discharge planning likely involves a more diverse and interprofessional social network. The components of the EBP transitional care set of risk assessment, medication reconciliation and discharge summary likely required participation of hospitalists, pharmacists, care transition coaches and other team members as well as members of the nursing staff. Study participants had the option to add up to four additional names or roles for each communication pattern item in the survey, few did so. As a result, the social network for patient discharge communication patterns was considered imprecise, partly due to the absence of non unit-based staff and the inclusion of staff, CNAs and night shift RNs, who may not have been actively engaged in patient discharge activities.

Post-acute settings. Leaders from the post-acute care organizations were asked to identify potential study participants who were likely to interact with the adult medical-surgical staff. Long-term care leaders recruited a greater number of staff representing day and night shifts as well as a diversity of roles (nurse, discharge planner, and supervisor) to participate in the study. In contrast, home care leaders identified only intake staff who primarily work days, but excluded field nurses who work both day and night shifts and who would have been more likely to interact with the hospital staff regarding post-discharge patient care. These differences in recruitment between long-term care and home care may have contributed to the absence of an association between the communication pattern variables and relationship quality for home care.

Response rate. Social network analysis describes the relationships among nodes in the social network. Thus, when response rates are low, relationships among non-respondents are

missing. Low response rates among some units limited which social network variables could be included in the analysis. Low response rates among some roles contributed to the removal of the social network for patient discharge communication patterns.

Unit level response rates. Half of the units in the sample had response rates of less than 50% which limited which social network variables could be used for analysis. Three social network variables, average path length, diameter, and core-periphery which are measures of distance between nodes and node position, become unstable when response rates are less than 50% and therefore were removed from the analysis. The removal of two social network variables, average path length and diameter, may explain a lack of correlation between the communication pattern variables and the communication quality variable, timeliness.

Role level response rates. Day shift RNs and discharge planning staff are accountable for the three measures of EBP adherence in this study. The low response rate from these staff (see Table 11, chapter 4) may explain why there were no significant associations between the social network for patient care communication. The low response rate also contributed to the decision to drop the social network for patient discharge communication from the analysis.

Evidence-based practice adherence. The selection and operationalization of the three evidence based transitional care tasks, risk assessment, medication reconciliation, and discharge summary was the third major limitation in this study. These tasks required input from non unit-based staff such as physicians and pharmacists. Since they were not part of the unit they were outside of the social network boundary and consequently did not receive a survey.

The operationalization of EBP adherence was the presence of documentation in the EMR that the task had been completed. While documentation of these tasks, risk assessment, medication reconciliation, and discharge summary, is mandated by CMS, hospitals may vary in

the extent to which institutional polices and processes are followed (L. O. Hansen et al., 2011a). In L. O. Hanson et al's report (2011a), the rates of documentation for mandated activities were no different than the rate of documentation for non-mandated activities. Furthermore, the authors noted that the existence of documentation was not synonymous with the quality of the documentation and a more useful measure would be to assess the quality of the documentation. That is, documentation was performed to meet the mandate, not for the purposes of communication. Hansen's findings may explain why there was no association between communication quality variables (openness and accuracy) and the operationalization of EBP adherence variables in this study.

The combined or interactive effect of the limitations resulted in a Type III error. A Type III error refers to the situation in which the data collected do not answer the research question that was posed (Ingersoll, 1996). The low response rate among day shift RNs and discharge planning staff as well as the omission of other staff integral to the completion of the transitional care tasks resulted in the removal of the more specific social network for patient discharge communication patterns from analysis. Instead, the more general social network for patient care communication patterns was used in the correlations which may explain why there were little to no significant associations between communication patterns (Stage 1) and relationship quality for home care (Stage 3), between communication patterns (Stage 1) and EBP Adherence (Stage 3), and between the communication quality variables, openness and accuracy, (Stage 2) and EBP Adherence (Stage 3) in the model. Put simply, correlating the social network variables for patient care communication patterns with variables specific to transitional care could not be used to fully test the Relational Model of Communication and Adherence to EBP.

It is important to note that while sampling and response rate issues may have precluded answering all of the research questions, there are a number of findings that address research questions related to associations between communication patterns, quality and relationships which offer an important foundation for future research. These findings are highlighted in the following discussion followed by how these findings can contribute to nursing theory and practice.

Interpretation of the Findings

The conceptual model for this study was developed from social network theory, diffusion of innovation theory, relational coordination theory, and quality improvement and EBP literature. The innovation in this study was using social network theory and social network analysis methods. Social network theory describes behavior based on the relationships between nodes within the social network whereas social network methods quantify these relationships. Because of the complexity of the model and the fact that social network terms are used throughout the interpretation, the communication pattern variable definitions and other foundational variables from social network theory and analysis are provided again in Table 20 to facilitate the reader's understanding of the interpretation.

The terms organization, institution, unit, social network, and group had distinct meanings in this chapter. Organization and institution refer to the hospital, home care agency, or long-term care facility. Unit refers to the medical-surgical unit within the hospital. Social network refers to the collection of communication dyads between and among staff on adult medical-surgical units. Group refers to the smaller social networks (fragmentation) within the larger unit-wide social network (density).

Table 20

Social Network Theory and Analysis Definitions

Communication Pattern Variable	Definition
Node	Entity within the social network. In this study, node referred to a staff nurse, discharge planner, supervisor, or CNA.
Tie	The presence of a relationship between two nodes.
Density	Extent of overall interconnected relationships within the entire social network.
Fragmentation	Distribution of relationships within a network; high fragmentation indicates the presence of groups or cliques within the social network; low fragmentation indicates one large group.
In-degree centralization	Pattern of information flow within the social network. High in-degree centralization represents a hierarchical communication pattern; low in-degree centralization represents a distributed or decentralized communication pattern.
Core-periphery (dropped from analysis)	Distribution and position of the nodes in the social network.
Average path length (dropped from analysis)	Average number of ties between any two nodes in the social network.
Diameter (dropped from analysis)	Largest number of ties between any two nodes in the social network.

Relationship between communication patterns (Stage 1) and communication quality (Stage 2). Table 21 lists the communication pattern and communication quality variables that were analyzed. Each of the three communication pattern variables was correlated with each communication quality variable.

Table 21

Communication Pattern Variables and Communication Quality Variables

Communication Patterns	Communication Quality
Density	Openness
Fragmentation	Accuracy
In-degree centralization	Timeliness

Of the nine correlations testing the relationship between communication patterns and communication quality see Figure 1, four were strong and statistically significant ($p < .10$), one was strong but not statistically significant ($r_s(10) = .49$, $p = .148$), and the remaining four correlations were weak and not statistically significant. The five strong correlations are discussed below.

Relationship between communication patterns (Stage 1) and communication openness (Stage 2). Openness, a component of communication quality, was defined as being able to say what you think without fear of repercussions or misunderstanding (Shortell et al., 1991). The quality of openness may also be used to describe whether a setting is likely to be supportive of new practice (French et al., 2009). The investigator hypothesized relationships between the communication pattern variables of density, fragmentation, and in-degree centralization with communication openness for both interpretations of openness. In the absence of literature support for the nature of these relationships, no direction was specified.

This association was not affected by the limitations described because communication (openness) is important in all aspects of patient care not just transitional care. Several of the hypothesized relationships were supported and provided information on the nature of the relationships. Of the three significant relationships between communication pattern variables and

the communication quality variable, openness, one was positive and two were negative. There was a strong and significant negative relationship ($r_s(10) = -.80$, $p = .005$) between the communication pattern variable, density, and the communication quality variable, openness. There also was a strong and significant negative relationship ($r_s(10) = -.57$, $p = .083$) between the communication pattern variable, in-degree centralization, and the communication pattern variable, openness. The two negative relationships are discussed first.

A social network with high density and high in-degree centralization suggests that the social network is not able to absorb new information. Taken together, the two negative relationships between each communication pattern variable, density and in-degree centralization, with communication openness were consistent with the open systems theory concept of an inwardly focused unit (Emery & Trist, 1965), i.e. one that is not attuned to outside influences such as external experts and advocates for new methods of practice. Nodes in an inwardly focused social network are likely to be homogeneous and obtain their information from the same one or two sources, a concept known in the social network and communication literature as knowledge redundancy (Burt, 1992, 2007; Granovetter, 1973). Once a new practice has been implemented, an inwardly focused environment is ideal for standardization and consistency. Process standardization minimizes risk, supports patient safety, and is the cultural norm in other industries (Miller, 2003). This standardization can happen on an inwardly focused unit because members of the network share a common vision and common knowledge which are considered qualities of a highly reliable organization (Mahlmeister, 2009; Miller, 2003). Crew resource management training in clinical settings, such as TeamSTEPPS (Agency for Healthcare Research and Quality, 2008), aims to cultivate similar qualities among clinicians in health care organizations (Mahlmeister, 2009; Miller, 2003).

Alternatively, these findings could be interpreted as staff in this environment could be resistant to implementing a new practice. A social network with high density and high in-degree centralization may be considered by some to be stifling or restrictive. Common vision, an asset in the previous paragraph, becomes a phenomenon known as *group think*, in which there are few opportunities for questioning and the densely connected strong ties provide high oversight to ensure that staff "follow the rules" (Cornwell, 2011; Hofmeyer & Marck, 2008; Mascia & Cicchetti, 2011), thereby making it difficult to introduce a new practice into the current workflow (Cornwell, 2011; Mascia & Cicchetti, 2011). Those who do not follow the prescribed processes may experience sanctions for unacceptable behavior or exclusion from the social network that is the unit (Coleman, 1988; Harris et al., 2006; Hofmeyer & Marck, 2008; Lyndon, 2008). As a result, nurses may refrain from speaking up, which can inhibit the flow of information among staff and potentially affect patient safety (Harris et al., 2006; Lyndon, 2008). These findings were also consistent with EBP adoption and adherence literature in which nurses reported little support from peers and supervisors when attempting to introduce new practice (Fink et al., 2005; Schoonover, 2009) and/or lacked authority to change practice (Atkinson et al., 2008; Fink et al., 2005; Karkos & Peters, 2006). The findings from this study suggest that open communication was not likely to occur in a large group of interconnected ties (high density) and/or when the communication pattern was hierarchical (high in-degree centralization), in which information flows downward from a few select individuals.

What are the implications? Communication openness is considered a positive characteristic in the early phases of implementation, which include the introduction, adoption, and initial spread of a new practice. The significant, negative associations between the communication pattern variables (density and in-degree centralization) and the communication

quality variable openness suggest that units comprised of a dense web of interconnected ties (high density) and a hierarchical communication flow (high in-degree centralization) may be counterproductive during the early phases of EBP adoption. However, these same social network characteristics may be more sought after once the new practice has been established. Given the negative relationships between the communication pattern variables (density and in-degree centralization) and openness suggest that the phase of implementation may be a moderating factor in understanding the relationship between communication patterns and communication quality and differentiating among competing hypotheses.

There was a strong and significant positive relationship ($r_s(10) = .72$, $p = .018$) between the third communication pattern variable, fragmentation and communication quality variable, openness. This finding suggested that open communication, including information sharing, advice seeking, and questioning, occurred within small groups of nurses who were connected by strong ties; yet, such communication was not always considered appropriate to share with the entire unit staff. The positive finding between fragmentation and communication openness in this study affirmed those by Benner et al. (2000), Estabrooks et al. (2005), Pravikoff et al. (2005), Profetto-McGrath et al. (2007), and others who reported that nurses turned to each other for information about practice. Within diffusion of innovations theory (Rogers, 1995), one factor associated with the rate of innovation adoption and diffusion is the ability to trial the innovation. Small groups or cliques, such as those measured by fragmentation, served as a safe environment to ask questions (Borgatti & Cross, 2003; Estabrooks et al., 2005) and to test the new practice before full implementation on the entire unit.

This finding was also consistent with strategies to trial new practices that had been reported in the literature, such as journal clubs and research days (Burns et al., 2009; Fink et al.,

2005; Karkos & Peters, 2006) that introduced small groups of nurses to new practices. Conversations within these smaller groups of relationships, measured as fragmentation, represented the beginning of an organizational diffusion process in which nodes in the larger social network might eventually adopt the practice and ensure staff adhere to the new practice (Kraatz & Moore, 2002; Tolbert & Zucker, 1996).

Taken together, the findings related to density, in-degree centralization, and fragmentation and openness suggest that different communication patterns among staff exert influence depending upon whether it is a new or an established practice. High fragmentation may be important in the early stages of the process, while high density and high in-degree centralization may be important to adherence for an established practice (Rangachari, 2008, 2010). The need for further study of the interaction among communication patterns and communication quality concepts in relation to the EBP practice life cycle is addressed in the section on future research.

Relationship between communication patterns (Stage 1) and communication accuracy (Stage 2). Accuracy, the second communication quality component examined in the model, was defined as the degree to which nurses believe that the information conveyed to them by other nurses was consistently correct and was adapted from Shortell et al. (1991). The investigator hypothesized relationships between the communication variables of density, fragmentation, and in-degree centralization with communication accuracy. In the absence of literature support for the nature of these relationships, no direction was specified.

This association was not affected by the limitations described because, like openness, communication (timeliness) is important in all aspects of patient care not just transitional care. There was a strong and significant positive association ($r_s(10) = .56$, $p = .093$) between density

and accuracy. When staff relationships were characterized by high overall interconnectedness (high density) there was a greater perception of accurate communication among staff on the unit. There was a moderate and non-significant negative relationship ($r_s(10) = -.49$, $p = .148$) between fragmentation and accuracy. That is, when staff relationships were characterized by a number of small interconnected groups (high fragmentation), there was a lower perception of accurate communication among staff on the unit. Because the relationship between fragmentation and accuracy approached a strong and statistically significant association and because density and fragmentation are measures of interconnectedness between and among nodes within the social network, these findings will be discussed together.

The findings regarding the associations between the communication pattern variables density and fragmentation and communication accuracy are consistent with concepts and findings from diffusion of innovation theory, social network literature on communication exchange, and knowledge translation literature. Understanding the importance of ties and tie strength in the exchange of communication and how information is defined is important to the interpretation of these findings. The communication pattern variables density and fragmentation are measures of relationship. Relationships or ties between and among nodes in the social network are the conduits through which information is exchanged. To understand the interpretation of these findings, it is important to review briefly the types of knowledge or information.

The literature on knowledge sharing differentiates between explicit and tacit knowledge (Polanyi, 1966 as cited in Brown & Duguid, 2001). Explicit knowledge is formal and codified; it is sometimes explained as *know what* (Brown & Duguid, 2001). In contrast, tacit knowledge is comprised of beliefs, understandings, skills, and practice (Anderson & Willson, 2009); it is

sometimes explained as *know how* (Brown & Duguid, 2001). Tie strength is critical to the successful information transfer for both types of knowledge. Explicit knowledge, such as medication reconciliation reports, is best exchanged using weak ties (Burt, 2007; Granovetter, 1973; Hansen, 1999). Complex, tacit information, such as interpreting a risk assessment, is best exchanged through strong ties (Burt, 2007; Granovetter, 1973; Hansen, 1999) because there is a common foundation of language and shared experience between parties. How well information is shared within the social network (who knows what) and the accuracy of the information (is the information correct?) is dependent upon whether the nodes are highly interconnected (density) or the nodes are clustered into smaller groups (fragmentation).

Perceptions of the accuracy of patient care communication in this study were influenced by both the level of density and fragmentation within the social network. There was a greater perception of accuracy when there was high interconnectedness among nodes within the unit overall (high density) and few smaller groups of interconnected ties (low fragmentation). The perception of accuracy was lower when there was low overall interconnectedness among nodes within the unit and a greater proportion of smaller groups with interconnected ties (low density/high fragmentation). When fragmentation is high, information about patient care may only be known within the small group and may not be shared among everyone in the larger group that is the unit. Information that is shared between groups may not be perceived as accurate by those in the receiving group (Brown & Duguid, 2001), or may be interpreted differently by the receiving group (Gittell & Weiss, 2004), such as between the emergency department and the inpatient unit.

There was a moderate and non-significant negative relationship ($r_s(10) = -.34$, $p = .334$) between the third communication pattern variable, in-degree centralization and communication

accuracy. The moderate and statistically non-significant association between these two variables suggests that there may be another unmeasured variable such as leadership style, teamwork, or demographic variables, including education and tenure in the organization, that would indicate cohesiveness among unit staff.

Relationship between communication patterns (Stage 1) and communication timeliness (Stage 2). Timeliness, the third component of communication quality studied in the model, is defined as the degree to which patient care information is relayed promptly to the people who need to be informed (Shortell et al., 1991). Timely communication describes how quickly communication travels through ties in the social network. Lack of timely communication may contribute to preventable hospital readmissions (Golden et al., 2010; Kirsebom et al., 2012; Lamb et al., 2011; Minott, 2008; Naylor et al., 2011). Communication frequency among staff may contribute to their perceptions of timeliness. The investigator hypothesized relationships between the communication pattern variables of density, fragmentation, and in-degree centralization with communication timeliness. In the absence of literature support for the nature of these relationships, no direction was specified.

Consistent with the limitations regarding participation rates and the subsequent removal of three social network variables (average path length, diameter, and core-periphery), the findings from this study did not support the hypothesized relationships. There were no statistically significant relationships between the communication pattern variables (density, fragmentation, and in-degree centralization) and communication timeliness. There was not a substantial relationship between density and timeliness ($r_s(10) = .06$, $p = .868$), or between fragmentation and timeliness ($r_s(10) = -.08$, $p = .828$). There was a moderate and non-significant positive correlation between in-degree centralization and timeliness ($r_s(10) = .36$, $p = .343$). The

moderate and statistically non-significant association between the communication pattern variables, density, fragmentation, and in-degree centralization with communication timeliness suggests that there may be unmeasured variables such as the social network variables that were dropped from the analysis due to low response rates among some units.

Although the hypothesized relationships between communication pattern variables and timeliness were not supported in this study, the hypothesized relationships can be inferred from other research findings. Studies of communication patterns in the emergency department reported that communication was more frequent (timely) among smaller intraprofessional groups (fragmentation) within the larger social network of the emergency department. Interprofessional communication, measured as communication between intraprofessional groups (boundary spanning communication), was less frequent (Creswick et al., 2009; Patterson et al., 2013). For example, emergency department nurses communicated more frequently with other emergency department nurses and emergency department physicians communicated more frequently with other emergency department physicians, which suggest strong ties among members of these social networks. Interprofessional communication, such as between nurses and physicians or between physicians and pharmacists, was performed by designated individuals within each intraprofessional group, boundary spanning ties (Creswick et al., 2009). Greater frequency of intraprofessional communication may be attributed to the homogeneity among individuals within the group or social network (Brown & Duguid, 2001).

Perceptions of timely communication may be more likely to be influenced by the distance between nodes, average path length and diameter, and their position, core-periphery, in the social network than their connections or communication flow. Distance takes into account the number of ties that are traversed to send a message from node A at one end of the social network to node

B on the other end of the social network. Communication flow, a contributor to communication timeliness, describes how communication travels through the social network, that is hierarchically (top down) or distributed among the nodes. If nodes A and B were connected through a single tie, then perceptions of timeliness would likely be high. If nodes A and B were not connected through a single tie, the message would have to pass through many ties until it reaches node B, and perceptions of timeliness would likely be low (see Figure 5).

Figure 5. Timely Communication as a Function of Node Distance.

In summary, of the nine correlations between communication pattern variables and communication quality variables, four correlations were statistically significant and one correlation approached statistical significance. Specifically, density was negatively associated with openness and positively associated with accuracy, fragmentation was positively associated with openness and negatively associated with accuracy, and in-degree centralization was negatively associated with openness. There were no statistically significant associations between the communication pattern variables and communication timeliness.

Moreover, the association between the communication pattern variables, density and fragmentation, with the communication quality variables, openness and accuracy, were consistent with findings describing nurse-to-nurse relationships by Benner et al. (2000),

Estabrooks et al. (2005), Ko (2011), Pravikoff et al. (2005), and Profetto-McGrath et al. (2007). This study provided empirical support for the use of social network theory and analysis to understand social network structure and their relevance to communication quality among nursing staff on adult medical-surgical units. The relationships between communication patterns and quality found in this study suggested these concepts may be used to understand how new practices may be introduced, spread, and maintained on hospital units.

Relationship between communication patterns (Stage 1) and relationship quality (Stage 2). Table 22 lists the communication pattern and relationship quality variables that were analyzed. Each communication pattern variable was correlated with the relationship quality variable, once for home care and again for long-term care, to understand the influence of the social network structure on the working relationships between acute and post-acute care settings.

Table 22

Communication Pattern Variables and Relationship Quality Variables

Communication Patterns	Relationship Quality
Density	Hospital unit relations with home care
Fragmentation	Hospital unit relations with long-term care
In-degree centralization	

For practical reasons, communication pattern data were only collected and measured from staff on the adult medical-surgical units; however, the home care agency and long-term care facility were included on the roster. Communication pattern analysis was limited to the hospital staff because EBP adherence was only measured for the hospital unit (Stage 1 to Stage 3) since this study was focused on relationships within the hospital unit and the interactions of unit staff with post-acute facility staff For this study, unit relations was defined as the aggregate

of individuals' perceptions of the working relationship with the other team. Relationship quality described how staff in one environment (acute care) perceived their working relationship with staff in another environment (home care and long-term care). The term *perceptions of relationship quality* will be used to refer to the unit relations variable.

Relationship between communication patterns and relationship quality with home care agencies. The investigator hypothesized relationships between the communication pattern variables of density, fragmentation, and in-degree centralization, measured only on the adult medical-surgical unit, with perceived relationship quality with home care agencies, measured among both the adult medical-surgical staff and participating home care staff. In the absence of literature support for the nature of these relationships, no direction was specified.

There was a moderate and non-significant positive relationship ($r_s(10) = .31$, $p = .383$) between density and relationship quality for home care. There was a moderate and non-significant negative relationship ($r_s(10) = -.31$, $p = .383$) between fragmentation and relationship quality for home care. Finally, there was a weak and non-significant negative relationship ($r_s(10) = -.12$, $p = .750$) between in-degree centralization and relationship quality for home care.

The lack of any significant relationships between the communication pattern variables and relationship quality for home care is consistent with the limitations regarding the social network composition since the more general social network for patient care communication pattern was used in the correlation rather than the more specific social network for patient discharge communication. In addition, the inclusion criteria for home care agencies was limited to the intake staff rather than the field nurses ; moreover, field nurses would be more likely to consult with the primary care provider for patient care information rather than the hospital unit.

Although the lack of specificity in the communication pattern measurement likely contributed to this finding, the literature suggests that the absence of a working relationship between these environments was common. Hospitals report that maintaining communication with home care agencies was difficult and information received from the home care agencies was inconsistent (Meadows & Boxer, 2008). Similarly, home care agencies also reported difficulties obtaining information from the hospital (Vaidya et al., 2012), and the quality of the information received from the hospital was poor (Hellesø, 2010; Hennessey & Suter, 2011; Naylor, 2006; Romagnoli et al., 2013; Smith, 2012). Ideally, the home care agency should at least receive whatever information the patient received upon discharge (The Joint Commission, 2008).

According to social network theory, sharing complex patient information across settings such as in transitional care activities requires strong ties. Differences in regulations, payments, and incentives (Alliance for Home Health Quality and Innovation, 2014; Naylor, 2006), as well as approaches to care (Hellesø, 2010; Naylor, 2006) between hospital and home care may limit the ability to establish strong ties between settings. Given these differences, there are no published guidelines to develop and support the creation of strong ties (Kelly & Penney, 2011), and transitional care models such as the Model of Transitional Care (Naylor et al., 1994) and the Care Transition Model (Coleman et al., 2006), likely sources for such guidance, do not include explicit communication ties between the hospital and home care agency (Alliance for Home Health Quality and Innovation, 2014). For these reasons, the lack of significant association between the hospital and home care agency may not be surprising.

Relationship between communication patterns and long-term care facilities. The investigator hypothesized relationships between the communication pattern variables of density, fragmentation, and in-degree centralization, measured only among the adult medical-surgical

unit, with perceived relationship quality for long-term care measured on the adult medical-surgical staff and participating long-term care staff.

Although the less specific social network for patient care communication patterns was used, there were significant associations between the variables. There was a strong and significant positive association ($r_s(10) = .58$, $p = .082$) between density and the aggregate perceived relationship quality with long-term care. That is, when there is greater overall interconnectedness among unit staff, there is more likely to be the same perception of the working relationship with the long-term care facility. There was a strong and significant negative relationship ($r_s(10) = -.66$, $p = .038$) between fragmentation and the aggregate perceived relationship quality with long-term care. That is, when there is less overall interconnectedness among unit staff, there is less likely to be agreement among staff regarding the perception of the working relationship between the staff from the long-term care facility and the staff from the hospital unit. There was a weak and non-significant positive association ($r_s(10) = .13$, $p = .713$) between in-degree centralization and the aggregate perceived relationship quality with long-term care. Because density and fragmentation are measures of interconnectedness between and among nodes within the social network, these findings will be discussed together.

Leaders from each post-acute organization identified staff to participate in the survey. Unlike the home care agencies which selected just intake staff, long-term care facilities included participants having a variety of roles across their organizations. The hypothesized relationship between communication patterns and relationship quality for long-term care was consistent with social network theory. According to social network theory, the successful exchange of complex patient information across care settings, such as that required for transitional care activities, requires strong ties. Long-term care facilities more closely resemble hospitals and may be owned

by the hospital's corporate organization. The long-term care facilities may be co-located on the same campus as the hospital, all of which provides a foundation to establish and nurture ties between organizations. Each hospital in this study instituted a cross-continuum transitional care workgroup, a recommendation from the STAAR Initiative (Boutwell et al., 2009), between one and two years before this study was conducted. Each workgroup was initially composed of hospital staff. Staff from some long-term care facilities were included within six months to a year after the workgroups were formed. Although not measured, staff from the participating long-term care facilities in the cross-continuum transitional care workgroup may have established strong boundary spanning ties with the hospital staff compared to non-participating long-term care facilities which may have had weaker ties with hospital staff.

There were differences in the communication patterns and relationship quality associations between the hospital and home care agencies and the hospital and long-term care facilities which may have been due to differences in the roles of the participating staff within the post-acute organizations. Lack of a statistically significant association between the hospital and home care agency suggests a weak tie and limited patient care information exchange between the settings, a finding reported in the literature (Hennessey & Suter, 2011; Naylor, 2006; Romagnoli et al., 2013; Smith, 2012; Vaidya et al., 2012). In contrast, in this study, the hospitals and long-term care facilities were more similar, were sometimes co-located on the same campus, and may have been part of the same parent organization, all of which could contribute to the establishment of a strong tie. Further, the evolving membership in the transitional care workgroups included members from long-term care facilities, well before the home care agencies were involved, and the meetings were held at both the hospital and long-term care facility, which may account for

the differences in perceptions of relationship quality between acute care and the home care agencies and between acute care and long-term care facilities.

Relationship between communication patterns (Stage 1) and evidence-based practice adherence (Stage 3). Table 23 lists the communication pattern and EBP adherence variables that were analyzed. Each communication pattern variable was correlated with each EBP adherence variable.

Table 23

Communication Pattern Variables and EBP Adherence Variables

Communication Patterns	EBP Adherence
Density	Risk assessment
Fragmentation	Medication reconciliation
In-degree centralization	Discharge summary

EBP adherence was measured on eight of the 10 adult medical-surgical units (2 units did not submit EBP adherence data) and was comprised of three evidence-based transitional care tasks (risk assessment, medication reconciliation, and discharge summary) from Project RED (Jack et al., 2008) and Project BOOST (Allendorf & O'Sullivan, 2014; Jencks et al., 2009; Society of Hospitalist Medicine, 2008). Of the nine correlations testing the relationship between communication patterns and EBP adherence (see Figure 1), none of the relationships were statistically significant. Findings for each correlation are organized by the EBP adherence variable. Interpretation of the non-significant relationships between communication patterns and EBP adherence will be discussed at the end of this section.

Relationship between communication patterns and risk assessment. Risk assessment, the first task under EBP adherence, refers to the 8P risk assessment (Allendorf & O'Sullivan,

2014; Jencks et al., 2009; Society of Hospitalist Medicine, 2008), a multi-pronged approach to assess the likelihood of patient readmission based on eight factors associated with readmission (Problem medication, Psychological, Principal diagnosis, Polypharmacy, Poor health literacy, Patient support, Prior hospitalization, Palliative care). The investigator hypothesized relationships between the communication pattern variables density, fragmentation, and in-degree centralization and the EBP adherence variable risk assessment. In the absence of literature support for the nature of these relationships, no direction was specified.

The findings from this study did not support the hypothesized relationships. There was a weak and non-significant positive relationship ($r_s(8) = .07$, $p = .863$) between density and risk assessment. There was a weak and non-significant positive relationship ($r_s(8) = .05$, $p = .909$) between fragmentation and risk assessment, and there was a weak and non-significant negative relationship ($r_s(8) = -.10$, $p = .818$) between in-degree centralization and risk assessment.

Relationship between communication patterns and medication reconciliation. Medication reconciliation, the second task under EBP adherence, refers to a process in which medications prescribed at discharge are compared with current medications and assessed for interactions and redundancy (The Joint Commission, 2006). The investigator hypothesized relationships between the communication pattern variables density, fragmentation, and in-degree centralization and medication reconciliation. In the absence of literature support for the nature of these relationships, no direction was specified.

The findings from this study did not support the hypothesized relationships, although there was a strong and positive association, approaching significance, ($r_s(8) = .51$, $p = .194$) between fragmentation and medication reconciliation. This finding suggests that medication reconciliation activity is more likely to occur in small, rather than large, groups. There was a

weak and non-significant negative association ($r_s(8) = -.29$, $p = .482$) between density and risk assessment, and there was a weak and non-significant negative association ($r_s(8) = -.20$, $p = .643$) between in-degree centralization and medication reconciliation.

Relationship between communication patterns and discharge summary. Discharge summary, the third measured task under EBP adherence, refers to communication between inpatient providers and providers at the next point of care such as primary care, home care, and long-term care. The investigator hypothesized relationships between the communication pattern variables density, fragmentation, and in-degree centralization and documentation of a discharge summary. In the absence of literature support for the nature of these relationships, no direction was specified.

The findings from this study did not support the hypothesized relationships. There was a weak and non-significant negative association ($r_s(8) = -.24$, $p = .560$) between density and discharge summary. There was a moderate and non-significant positive association ($r_s(8) = .42$, $p = .307$) between fragmentation and discharge summary. And there was a moderate and non-significant negative association ($r_s(8) = -.44$, $p = .276$) between in-degree centralization and discharge summary.

Communication patterns and evidence-based practice adherence interpretation. The hypothesized relationships between communication pattern variables (density, fragmentation, and in-degree centralization) and the EBP adherence variables (risk assessment, medication reconciliation, and discharge summary) were not supported empirically. These findings are consistent with the methodological issues that were encountered during the analysis phase of this study, and described previously under limitations. Furthermore, the investigator's review of the

literature found no research to support these relationships between the social network variables and EBP adherence.

Relationship between communication quality (Stage 2) and evidence-based practice adherence (Stage 3). Table 24 lists the communication quality and EBP adherence variables that were analyzed. Each communication quality variable was correlated with each EBP adherence variable.

Table 24

Communication Quality Variables and Evidence-based Practice Adherence Variables

Communication Quality	EBP Adherence
Openness	Risk assessment
Accuracy	Medication reconciliation
Timeliness	Discharge summary

Of the nine correlations testing the relationship between communication quality and EBP adherence (see Figure 1), two were strong, negative, and statistically significant; the remaining seven correlations were weak and non-significant. Interpretation of the statistically significant and non-significant relationships between communication quality variables and EBP adherence will be discussed at the end of this section.

Relationship between communication quality and risk assessment. The investigator hypothesized relationships between the communication quality variables (openness, accuracy, and timeliness) and risk assessment. In the absence of literature support for the nature of these relationships, no direction was specified.

There was one strong and significant negative relationship ($r_s(8) = -.86$, $p = .006$) between timeliness and risk assessment. A completed risk assessment form (chart or EMR) can

be considered a form of communication alerting the clinical team to the presence of factors associated with an increased risk of hospital readmission (e.g., polypharmacy or need for palliative care). If one considers the risk assessment form as a type of communication, then the finding can be interpreted as there was less need for timely communication (between staff) when there was evidence in the EMR that the risk assessment had been performed.

The remaining two relationships were non-significant. There was a moderate but non-significant negative relationship ($r_s(8) = -.47$, $p = .244$) between openness and risk assessment and there was a weak and non-significant negative relationship ($r_s(8) = -.25$, $p = .954$) between accuracy and risk assessment. Lack of an association between variables may indicate the presence of an unmeasured variable. The lack of association may also be due to using the more general social network for patient care communication patterns rather than the more specific social network for patient discharge communication patterns (See the discussion under limitations). Furthermore, the communication quality variables openness and accuracy reflect the quality of the risk assessment report content, which was not measured in this study.

Relationship between communication quality and medication reconciliation. The investigator hypothesized relationships between the communication quality variables openness, accuracy, and timeliness and medication reconciliation. In the absence of literature support for the nature of these relationships, no direction was specified.

The findings from this study did not support the hypothesized relationships. There was a weak and non-significant negative relationship ($r_s(8) = -.12$, $p = .772$) between openness and medication reconciliation. There was a weak and non-significant negative relationship ($r_s(8) = -.17$, $p = .684$) between accuracy and medication reconciliation. There was a strong and negative relationship which approached significance ($r_s(8) = -.52$, $p = .191$) between timeliness and

medication reconciliation. As noted with risk assessment, lack of an association between communication quality variables and medication reconciliation may have been due to limitations in EBP adherence measurement.

Relationship between communication quality and discharge summary. The investigator hypothesized relationships between the communication quality variables openness, accuracy, and timeliness and documentation that a discharge summary was completed. In the absence of literature support for the nature of these relationships, no direction was specified.

One relationship was statistically significant. There was one strong and significant negative relationship ($r_s(8) = -.74$, $p = .037$) between timeliness and discharge summary. As discussed under risk assessment, the finding can be interpreted as there was less need for timely communication (between staff) when there was evidence in the EMR that the discharge summary had been performed.

Two relationships were not statistically significant. There was a weak and non-significant negative relationship ($r_s(8) = -.20$, $p = .641$) between openness and discharge summary, and there was a weak and non-significant negative relationship ($r_s(8) = -.10$, $p = .817$) between accuracy and discharge summary. Lack of an association between variables may indicate the presence of an unmeasured variable. As noted earlier with risk assessment, lack of an association between communication quality variables and discharge summary may have been due to limitations in EBP adherence measurement.

Summary findings of relationships between communication quality and evidence-based practice adherence. Communication can be described as being oral or written and also objective or subjective. The communication quality items adapted from the ICU Nurse-Physician Questionnaire (Shortell et al., 1991) in this study referred to oral communication; for example, “I

find it enjoyable to talk with other nurses of this unit." In contrast, the EBP adherence variables could be considered written communication about the patient plan of care upon discharge. Risk assessment and discharge summary can be considered more subjective, written communication requiring interpretation from the reader; whereas medication reconciliation can be considered objective, written communication in which the information about medication is readily available.

Although few of the relationships between communication quality and EBP adherence were supported in this study, support for these relationships may be found in the quality improvement literature. Manojlovich and Antonakos (2008) explored the influence of communication using the ICU Nurse-Physician Questionnaire communication scales (Shortell et al., 1991) in the practice environment and specific patient outcomes (pressure ulcers, ventilator acquired pneumonia, and blood stream infections associated with central line catheters). Timeliness was negatively associated, although not significantly, with two of the patient outcome measures (pressure ulcers and blood stream infections), which the authors interpreted as when communication was the incidence of pressure ulcers and infection was low (Manojlovich & Antonakos, 2008). In this study, the influence of communication was on EBP adherence, rather than patient outcomes. Future studies that use The Relational Model of Communication and EBP Adherence may consider including a measure of patient outcomes in order to explore the relationship between communication quality variables, openness and accuracy, and EBP adherence.

In conclusion, timely (oral) communication was more likely to be high when there was no evidence in the EMR of the subjective written communications, risk assessment and discharge summary. Timely communication was not significantly associated with medication reconciliation, an objective communication. Openness and accuracy, measures of the content

quality were not associated with any of the three EBP adherence variables, since only presence and absence of the written communication was measured. These findings suggest that timely oral communication may be less critical in the presence of written communication.

Relevance to Nursing Theory and Practice

EBP adoption and adherence among nurses has been studied from individual and group perspectives for at least four decades (Squires, Hutchinson et al., 2011), yet the rate at which nurses adopt and adhere to EBP has not increased significantly; the profession is still trying to understand why. Effective communication between shifts, professions, and settings to share patient information is integral to care coordination and care transitions. A common finding among some studies is that nurses look to other nurses for information regarding practice (Benner et al., 2000; Estabrooks et al., 2005; Ko, 2011; Pravikoff et al., 2005; Profetto-McGrath et al., 2007), suggesting that social networks (meaning peer relationships) may be important. This finding was the impetus for this study. This study explored the influence of the communication patterns (social networks) among nursing (RN, LPN, CNAs) and discharge planning staff on the adherence to evidence-based care transition tasks. The findings have substantive implications for nursing theory and practice which are discussed in the following section.

Relevance to nursing theory. Diffusion of innovations theory (Rogers, 1995) is a common theoretical framework used in EBP research. The Ottawa Model of Research Use and PARIHS are two well-known EBP evaluative frameworks used to ascertain an organization's readiness to adopt a new evidence-based practice and/or to evaluate the processes and outcomes of the implementation of an EBP initiative. These frameworks draw on and are congruent with Rogers' (1995) paradigm, which identified the influence of communication channels to foster the

spread of adoption of an innovation within the social system. In OMRU and PARIHS, the social system is referred to as the context or environment where the new practice will be (or has been in the case of post-implementation) embedded. Within this environment there are formal and informal (opinion) leaders. The PARIHS model specifically identifies the importance of relationships in the adoption of EBP and includes peer relationships in the definition of context. Social network theory and social network analysis, especially the concept of knowledge sharing, provide ways to understand and leverage the influence of these peer relationships on nurses' adoption of and adherence to EBP.

The discussion of formal and informal opinion leaders in the quality improvement and diffusion of innovation literature is consistent with the social network concepts of in-degree centralization. The social network concepts of density and fragmentation are used to describe the extent and pattern of peer relationships. These social network concepts are consistent with findings from studies by Benner et al. (2000), Estabrooks et al. (2005), Ko (2011), Pravikoff et al. (2005), and Profetto-McGrath et al. (2007), which describe how nurses obtain information and support from each other.

Findings from this study also extend what we know about the nature of peer relationships among nurses and their influence on staff's perceptions of communication quality (openness, accuracy, and timeliness). These peer relationships provide the means to establish and share tacit group knowledge (Nonaka, 2002), a contributor to unit culture (Kitson et al., 1998). Tacit group knowledge, described as *how things are done here*, serves as a filter to evaluate new practice (Dopson et al., 2002). Findings from past research, viewed through a social network lens, suggest that units with strong, dense ties and low fragmentation combined with a hierarchical communication flow often have been found to have high adherence to current practice, but these

same characteristics may prohibit the introduction of new practice (low openness and high accuracy). Nurses on these units who try to introduce a new practice may report that they do not have authority or support from peers and supervisors to introduce a new practice (Atkinson et al., 2008; Fink et al., 2005; Karkos & Peters, 2006; McCaughan et al., 2002; Schoonover, 2009). In contrast, in units where there is less cohesion (high fragmentation), staff will be more likely to adopt new practice but may not be able to maintain adherence to the new practice because there is a low perception of accuracy. Further examination of the relationships between communication pattern variables, density, fragmentation, and in-degree centralization, and communication quality variables, openness and accuracy may provide more information about the role of peer relationships throughout the phases of EBP introduction, implementation, and adoption and thus, extend the OMRU and PARIHS models concept of environment/context.

Relevance to nursing practice. Results from this study support findings by Benner et al. (2000), Estabrooks et al. (2005), Hansen et al. (1999), Ko (2011), and others, that nurses use social networks to obtain information This study highlights the potential importance of these peer relationships and communication to facilitate the adoption of and adherence to EBP. In addition, study findings provided initial support for the relationship between communication patterns and communication quality and some relationships between communication quality and EBP adherence variables. These findings suggest that further evaluation of nurses' social networks is a fruitful area for understanding the introduction and adoption of new EBP practices.

The implementation and evaluation of EBP in an organization is often part of a larger quality improvement initiative, such as decreasing the rate of hospital acquired conditions. Among organizations that use the OMRU or PARIHS frameworks, social network analysis and analysis of communication quality may provide additional ways to evaluate the context or

environment where a new practice will be implemented (see Arling et al., 2011 for an example). Social network theory and social network methods enable researchers to explore the structure of staff relationships within the environment and the influence and interaction of social network variables with communication quality and relationship quality variables to understand and influence the spread of adoption and adherence to EBP for both theory and practice.

Recommendations for Future Research

Some of the hypothesized relationships within the Relational Model of Communication and Adherence to Evidence-based Practice were not supported during initial testing which may be a consequence of the three major limitations described at the beginning of this chapter, (a) sample, (b) response rate, and (c) the selection and operationalization of the evidence-based activities. Furthermore, the small sample size limited the generalizability of the findings as well as the ability to perform some statistical analyses. Recommendations to address the described limitations are discussed first, followed by recommendations to extend the model, and finally areas for future research.

Recommendations to address the limitations. The combination of the evidence-based transitional care tasks and the inclusion criteria had a negative, cascading effect on the findings from this study. The recommendations described in this section may be helpful to investigators for future studies to limit the issues this investigator encountered. EBP adherence is described first since the subsequent recommendations for response rate and survey design depend upon the selection of the measures of EBP adherence.

Evidence-based practice adherence. EBP adherence for the three evidence-based tasks for this study was operationalized as the presence or absence of documentation in the EMR. According to L. O. Hanson and colleagues (2011a) documentation of a task is not synonymous

with the quality of the task, therefore, investigators for future studies would be advised to consider additional means to measure adherence including one or more measure of performance quality. Performance quality could be measured through chart review and participants' perceptions of the quality of the performed task.

Inclusion criteria. Participant inclusion criteria are informed by the investigator's selection of the evidence-based tasks. Two recommendations can be made to ensure better alignment between the task and the participant inclusion criteria. First, the investigator should review the relevant policies for the designated EBP tasks to discover which staff roles are associated with implementing the EBP protocol. Next, the investigator should conduct a more structured process for identifying who is responsible and/or who is leading the implementation from the perspective of unit leaders and staff. While a policy may identify staff roles critical to implementation, other individuals (informal leaders and champions) may be the ones ensuring implementation and adoption. One strategy for identifying relevant roles and names for inclusion within communication pattern survey items roster would be for the investigator to conduct key informant interviews asking managers and staff to identify the people and to clarify the roles and individuals of those implementing the protocol. Due to the improved alignment between EBP task and more precise inclusion criteria, the potential number of participants comprising the social network should be smaller. It may be easier to achieve a 50% response rate for all units when there is a smaller social network comprised only of individuals engaged in the evidence-based tasks.

Response rates. Unit response rates of less than 50% prevented the inclusion of three communication pattern variables as part of the analysis: average path length, diameter, and core-periphery which are measures of distance and node position within the social network.

Investigators for future studies may have to use more than one strategy to target leaders and staff in order to achieve the desired response rates of at least 50% for all of the units in the sample. The following three recommendations are suggested as examples of such strategies. The first recommendation is to actively engage nurse leaders as part of the site recruitment protocol. In this study, units having high response rates were units where the nurse leader was included in the site recruitment process. The second recommendation is to provide individual incentives such as gas or grocery cards, or other marketing incentives, as well as group level incentives based on response rates; this investigator used only group level incentives. The third recommendation is to publicize the study at the research site well in advance of the start of data collection. Some nurses may not have participated in the study because they were concerned about workplace privacy or believed that this study of social networks was about nurses' use of Facebook. Examples of advance publicity include time on the agenda to describe the study at staff meetings, sending emails to the pool of potential participants, and hanging posters with a clear explanation of social networks in the study context and a description of the study's purpose. Since future investigators may have difficulty engaging with the entire pool of potential study participants in a unit to talk about the study, the investigator should consider embedding a web address in the publicity email and placing a QR code on posters. The web address and QR code could which could link to a video in which the investigator explains the purpose of the study, types of questions, and how the data will be used. In addition, participant response rates may have been affected by the survey design.

Communication pattern survey items. Survey design can be a threat to the validity of social network data (Borgatti et al., 2013; Prell, 2012). The lengthy roster of names and resulting response burden may have contributed to the low response rate, especially among day shift RNs

and discharge planning staff encountered in this study. The following recommendations are suggested to address these potential threats.

As mentioned earlier, more specific inclusion criteria will decrease the number of potential participants and thus reduce the number of entries in the roster under each communication pattern item. Should it be necessary to collect data to measure more than one communication pattern/social network the item stem and placement of the item is important. The investigators of future studies would be advised to provide examples of the type of communication requested within the item stem. Also, the more relevant survey item should be placed first in order to avoid dropping the item due to a lack of useful data. Designing the survey so that participants can indicate with whom they communicate regarding patient care and patient discharge without a timeframe and with a rating scale such as *always, usually, sometimes, never* (and defining parameters for each choice on the scale) may provide more accurate information about the relationships on the unit and may be easier for respondents since it does not depend upon a defined recall period.

Sample size. A small sample size in this study limited the types of statistical analyses that could be performed. Recruiting a sufficient number of units from a variety of environments and types of hospitals to perform regression analysis would be useful to understand the associations and interactions among all of the variables in the model. The increase in the number of participating units would allow for appropriate statistical analyses and allow for the generalizability of the findings.

In conclusion, the focus of these recommendations was to address the limitations described at the beginning of this chapter. Participant inclusion criteria informed by the EBP task selection would provide greater compatibility between participant and task, there would likely be

a smaller social network. Due to the expected smaller network size, the minimum 50% response rate among all units may become more likely. These suggestions pertain to the first test of the Relational Model for Communication and EBP Adherence. Recommendations to extend the model are described in the following section.

Model extension. This first test of the Relational Model of Communication and EBP Adherence was intentionally limited in scope in order to explore the influence of the social network on communication quality, relationship quality, and EBP adherence. The findings from the first test of the model highlighted areas for additional clarity and ideas for improved specification of model variables and relationships in future research. Three areas for further model development and testing include: identifying mediating and moderating variables; using more precise measures of oral and written communication quality between acute and post-acute settings; and using research designs that incorporate multilevel analysis.

Mediating and moderating variables. Mediating and moderating variables are variables that can further explain the relationship between an independent and a dependent variable. Mediating variables provide additional information about the nature of the relationship whereas moderating variables change the strength and direction of the association (Bennett, 2000). The investigator had assumed that a full test of the model, which would have included the social network for patient discharge communication and the social network variables for node position and distance, would reveal potential moderating and mediating variables that might be prioritized for inclusion in the model in future studies. However, since a full test of the model was not realized, the investigator can only hypothesize possible mediating and moderating variables based on findings from the quality improvement literature.

In the national ICU study, for example, Shortell and colleagues (1992) reported that higher performing ICUs shared similar traits. Communications in high performing units were characterized by more extensive communication within the unit, between units, and between the unit staff and management. In these units, communication was also considered a teaching strategy. Furthermore, leadership in high performing units was shared among formal and informal leaders. These findings about communication suggest that social network variables such as in-degree centralization and tie strength may serve to mediate the relationship between communication quality and EBP Adherence. In-degree centralization describes how communication travels within the social network, thereby providing additional information about the relationship between communication quality and EBP Adherence. High in-degree centralization suggests that communication is hierarchical or top down whereas low in-degree centralization suggests that communication is distributed among nodes in the social network. Communicating complex information requires strong ties which could provide additional information about the relationship between the communication quality variable, openness, and EBP Adherence. The findings about leadership suggest that leadership style may moderate the relationship between the social network variable, in-degree centralization, and the communication quality variable, openness.

Communication between acute and post-acute settings. Poor oral and written communication between care settings contributes to the likelihood of a preventable hospital readmission (American Nurses Association, 2012; Forster et al., 2004; Naylor et al., 2012; Nosbusch et al., 2011). In future tests of the model, in addition to relationship quality, communication quality (oral communication), should be measured between staff in acute and post-acute organizations.

Multilevel analysis. Factors at individual, unit, and organization levels, as well as between these levels, may contribute to the rate of EBP adherence. The complexity of implementing EBP practices to prevent hospital readmissions suggests the need for a multilevel approach (Dopson, 2007; Estabrooks, 2007; Shortell, 2004). Although this study used social network research methods and existing scales for non-social network variables (communication quality and relationship quality), these methods and measures can be used in multilevel analyses;

Additional areas for future research include (a) evaluating the quality of oral and written intra- and interagency communication among staff and (b) conducting longitudinal studies to assess changes in communication patterns and changes in communication quality over time. Effective communication is foundational to successful patient discharge (Golden et al., 2010; Kirsebom et al., 2012; Lamb et al., 2011; Minott, 2008). Findings from the literature suggest that communication across settings may be inconsistent and of low quality (Golden et al., 2010; Kirsebom et al., 2012; Lamb et al., 2011; Minott, 2008; National Transitions of Care Coalition, 2010; Naylor et al., 2011) particularly because important information critical to patient care has been omitted (Dawson, 2007; Golden et al., 2010; Nosbusch et al., 2011; Witherington et al., 2008). In this study, the relationship between communication quality and EBP adherence was measured for acute care staff, but the relationship was not tested between hospital staff and the home care agency or between hospital staff and the long-term care facility. Future research is needed to explore perceptions of oral and written communication (communication quality and the quality of the EBP adherence constructs) between staff in acute and post-acute environments

Finally, it is understood that a social network structure changes over time. A longitudinal study is needed to explore changes in the unit's social network as the new practice moves from adoption to adherence. The findings from this study suggest when there is high fragmentation

(low density/interconnectedness) and low in-degree centralization (distributed communication) there is a greater perception of communication openness, ideal for the introduction of new practice, however, low perceptions of communication accuracy among staff on the unit is an impediment for adhering to practice. In contrast, social networks with high density (low fragmentation) have greater group level perceptions of accuracy, conducive to the adherence of current practice. However, high density or interconnectedness on the unit is associated with low perceptions of open communication. Considering the importance of the social network structure to adopt and adhere to EBP, social network methods may be useful to study the interventions to improve communication and ties within the unit as well as between units in the hospital and between the hospital and other organizations.

Summary. The recommendations in this section were drawn from the limitations discussion at the beginning of this chapter. These recommendations can be grouped into three categories (a) recommendations to address the limitations in the study design leading to a Type II error, (b) recommendations to fill in the details of the model design for example, evidence of mediating and moderating variables, and (c) recommendations for future research which include a longitudinal study and measures of oral and written communication quality between organizations

Conclusion

This study was one of the first to apply social networks theory and research methods to address the issue of nurses' adoption of and adherence to EBP within the context of transitional care. The Relational Model of Communication and Adherence to Evidence-based Practice was developed using a synthesis of theory and literature from four areas: (a) diffusion of innovation theory, (b) social network theory, (c) relational coordination theory, and (d) quality improvement

and EBP adoption and adherence. Initial model testing using the patient care communication pattern supported eight of the hypothesized relationships. Among the supported relationships, five of these relationships were between Stage 1, communication patterns, and Stage 2, communication quality and relationship quality. Further model testing in which the communication patterns (the ties in the social network) are more closely aligned with those responsible for implementing and adhering to the EBP adherence variables may yield additional significant relationships.

This initial test of the Relational Model of Communication and Adherence to Evidence-based Practice suggests the importance of relationships and communication as facilitators and impediments to the adoption of and adherence to EBP. These results begin to unpack the findings from other studies which describe how "clinical and caring knowledge are socially embedded" (Benner et al., 1997, p. 16BBB) and may explain the finding from the national study by Pravikoff et al. (2005) on nurses' readiness to adopt EBP that more than 50% of respondents turn to colleagues or peers for nursing information. More specifically, the findings from this study begin to explain how the social network structure (high density versus high fragmentation) and the way that the communication flows within the social network (top-down or distributed) are influential in the adoption and adherence to new practice. Social network theory is congruent with nursing theories on EBP implementation; social analysis methods provide an important and valid strategy for better understanding and improved operationalizion of these theories. This study and further model testing may change how new practice is introduced as well as suggest novel ways to promote adherence to EBP among staff. Ultimately, this and future studies using the Relational Model of Communication and Adherence to Evidence-based Practice may help

shorten the period from research to implementation and help to reduce the rate of preventable hospital readmissions.

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APPENDIX A

INSTRUMENTS

Communication Patterns

To whom do you talk about patient care?

The names listed in this section are nurses, CNAs, and discharge planners who worked on this unit in the last 30 days. For each name, **please circle the response** that best reflects how frequently you communicate with that person about **patient care**.

By communicating I mean conversation in person or over the phone, email, and texting/instant messaging.

1. XXXXXXX
   - ○ Don't know
   - ○ Know, but don't discuss patient care
   - ○ Monthly
   - ○ Weekly
   - ○ Daily

To whom do you talk about patient discharges?

The names listed in this section are nurses, CNAs, and discharge planners who worked on this unit in the last 30 days. For each name listed below, please circle the response that best reflects how frequently you communicate with that person about **patient discharge**.

By communicating I mean conversation in person or over the phone, email, and texting/instant messaging.

1. XXXXXXXXXXX
   - ○ Don't know
   - ○ Know, but don't discuss patient discharge
   - ○ Monthly
   - ○ Weekly
   - ○ Daily

Communication Quality
Communication Among Nurses, CNAs, and Discharge Planners on this Unit

The questions in this section address communication among nurses, CNAs and discharge planning staff within the unit. By nursing staff I mean both nurses and CNAs on the unit. Please circle your response.

Nurse and CNA (nursing staff) communication

1. **It is easy for me to talk openly with the nursing staff on this unit.**

   ○ Strongly Disagree ○ Disagree ○ Neither Disagree nor Agree ○ Agree ○ Strongly Agree

2. **I can think of a number of times when I received incorrect information from nursing staff on this unit.**

   ○ Strongly Disagree ○ Disagree ○ Neither Disagree nor Agree ○ Agree ○ Strongly Agree

3. **It is often necessary for me to go back and check the accuracy of information I have received from nursing staff on this unit.**

   ○ Strongly Disagree ○ Disagree ○ Neither Disagree nor Agree ○ Agree ○ Strongly Agree

4. **I find it enjoyable to talk with other members of the nursing staff on this unit.**

   ○ Strongly Disagree ○ Disagree ○ Neither Disagree nor Agree ○ Agree ○ Strongly Agree

5. **The accuracy of information passed among nursing staff of this unit leaves much to be desired.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

6. **It is easy to ask advice from nursing staff on this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

7. **I feel that certain nursing staff don't completely understand the information they receive.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

8. **I get information on the status of patients from nursing staff when I need it.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

9. **When a patient's status changes, I get relevant information from nursing staff quickly.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

10. **In matters pertaining to patient care, nursing staff call physicians in a timely manner.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

Patient discharge planner communication

1. **It is easy for me to talk openly with the discharge planners covering this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

2. **I can think of a number of times when I received incorrect information from discharge planners covering this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

3. **It is often necessary for me to go back and check the accuracy of information I have received from discharge planners covering this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

4. **I find it enjoyable to talk with other discharge planners covering this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

5. **The accuracy of information passed among discharge planners covering this unit leaves much to be desired.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

6. **It is easy to ask advice from other discharge planners covering this unit.**

o Strongly	o Disagree	o Neither Disagree	o Agree	o Strongly

Disagree nor Agree Agree

7. I feel that certain discharge planners don't completely understand the information they receive.

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

8. I get information on the status of patients from other discharge planners when I need it.

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

9. When a patient's status changes, I get relevant information from discharge planning staff quickly.

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

10. In matters pertaining to patient care, discharge planners call physicians in a timely manner.

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

Relationship Quality
Working Relationship with Home Care and Long-term Care

The questions in this section focus on the relationship between your unit and Home Care and Long-term care facility. **Please circle your response.**

Relationship with Home Care

1. **Our unit has constructive work relationships with Home Care.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

2. **Our unit does not receive the cooperation it needs from Home Care**.

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

3. **Home Care seems to have a low opinion of this unit.**

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

4. **Inadequate working relationships with Home Care limit our** effectiveness.

o Strongly Disagree	o Disagree	o Neither Disagree nor Agree	o Agree	o Strongly Agree

Relationship with long-term care

1. **Our unit has constructive work relationships with long-term care.**

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

2. **Our unit does not receive the cooperation it needs from long-term care.**

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

3. **Long-term care seems to have a low opinion of this unit.**

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

4. **Inadequate working relationships with long-term care limit our effectiveness.**

○ Strongly Disagree	○ Disagree	○ Neither Disagree nor Agree	○ Agree	○ Strongly Agree

Demographic Questions

These questions are about you. Please circle your response.

1. **What is your role?**

   - o CNA
   - o Nurse (LPN, RN, Advanced Practice)
   - o Supervisory
   - o Admission/Care coordination

2. **What is your level of preparation?**

   - o Diploma
   - o AD
   - o Baccalaureate
   - o BSN
   - o Master's
   - o Doctorate (ND, PhD, DNP, EdD)
   - o None of the above

3. **Which shift do you usually work on the unit? Select the answer that best describes when you usually work on the unit.**

   - o Days
   - o Evenings/Nights

4. **How many years have you been in your profession?**

   - o <1 year
   - o 1-5 years
   - o 6-15 years
   - o 16+ years

5. **How many years have you worked for your organization?**

   - o <1 year
   - o 1-5 years
   - o 6-15 years
   - o 16+ years

6. **Are you classified as Float/Travel/Per Diem?**

   - o yes
   - o no

7. **Have you participated in any organization-wide committees? When?**

- o I have never participated
- o Within last 3 years
- o More than 3 years ago

8. What is your level of participation within your professional organizations?

- o Not a member/Does not apply
- o Am a member do not participate
- o Read the publication(s)
- o Attend local meetings

APPENDIX B

CHIEF NURSING OFFICERS LETTER

Dear XXXXXXX:

My name is Nan Solomons and I am a data analyst in the MaineHealth Center for Quality and Safety with Janet Smith. I am also in my 5th year of a doctoral program at the Arizona State University College of Nursing and Health Innovation. I am writing to you to see whether you would be interested in having the medical-surgical nursing staff in your hospital participate in my dissertation research study. My research is on the impact of working relationships on communication and adherence to evidence-based practice to reduce avoidable hospital readmissions.

As you well know, hospital readmission rates are a hot topic in the literature because of changes in Medicare reimbursement and value-based purchasing programs. And due to higher costs and lower reimbursement rates, hospital leaders are seeking innovative methods to address the problem of avoidable readmissions, especially among the frequent utilizers who account for a greater percentage of human and financial resources. Unfortunately, there isn't a one-size fits all solution among the many interventions. However, interventions that improve the communication on the unit and across settings have reported positive results for minimal cost and training.

For my research, I plan to administer a one-time survey to the med-surg nursing staff, including CNAs, and discharge coordinators covering the unit. The survey will cover

1) whom nurses talk to about patient care and discharge planning during a specified 30 day period
2) nursing staff, CNAs, and discharge planners' perceptions of communication within the unit;
3) communication between the med-surg unit and post-acute care organizations (home health and long term care)
4) demographic data.

Nursing staff from designated home health and acute care organizations will also be surveyed about their perceptions of communication with the med-surg unit. In addition, I will capture rate of adherence to three measures in the Care Transition Bundle, 1) risk assessment, 2) medication reconciliation, and 3) post discharge communication. A copy of my abstract is attached. Based on my review of the literature this is the first study on hospital readmission that includes the social network of the unit, perceptions of communication on the unit and perceptions of communication with post-acute care organizations, and a set of interventions to address hospital readmission. I have included an article by Hofmeyer and Marck from *Nursing Outlook* (2008) that describes how an understanding of the nurses' social network can impact patient care and collaboration which provides some context for my proposed study.

At the end of the study, the de-identified information will be presented to you in aggregate. These results could be useful to understand how information is exchanged among the nursing staff on the unit and inform how new evidence-based initiatives are rolled out to the unit.

Several of your CNO colleagues have expressed an interested in participating in my research. If you are interested in engaging in this research with me, I would welcome the opportunity to come to Rockport to talk with you in person in greater detail about my research project.

Sincerely,

Nan M. Solomons, MS
Doctoral Student, College of Nursing and Health Innovation
Arizona State University
nan.solomons@gmail.com
Data Analyst III, MaineHealth Center for Quality and Safety
solomn@mainehealth.org
207-775-2570 H
207-662-1544 W

APPENDIX C

LETTER OF INTRODUCTION

Hello.
My name is Nan Solomons; I am a data analyst at MaineHealth and have lived in Maine for 10 years. I am also a doctoral student in the College of Nursing and Health Innovation at Arizona State University. My dissertation is on the role of communication and nurses' relationships in patient care and adherence to evidence-based practice (EBP) and will be conducted in Maine. To my knowledge, this is the first study to explore how nurses working relationships are associated with patient care, patient discharge and adherence to EBP. Your CNO and manager have agreed to allow me to conduct my research on your unit and to invite you to participate in this study. Please note that this study and this invitation to participate are **solely related to my dissertation research** and are separate and independent from my work at MaineHealth.

In this packet you will find a consent form for your records, a paper survey, and a large envelope. The survey consists of four parts: (1) who you talk to on the unit about patient care and patient discharge and how frequently you talk to them; (2) how you perceive the communication on the unit among the nurses, CNAs, and discharge planning staff (3) how you perceive the communication between your unit and home care agency and long term care facility; and (4) some questions about you. If you are interested in participating in my research, please fill out the enclosed survey. The survey should take no more than 20 minutes to complete. Once you have completed the survey, place it in the envelope. Seal the envelope and deposit it in the brightly wrapped box labeled SOLOMONS DATA in the break room.

I'd very much appreciate it if you would complete the survey and deposit in the box within the next week.

If you would prefer to take this survey online, go to http://goo.gl/F9Zsor. You will need your **participant id (31-3571)** which can be found in the top right corner of this document. It's very important for this study, that at least half of the eligible people on this unit complete the study. Even better, would be 80%. A 50% response rate is the minimum sample size necessary to perform social network analysis at the unit level. Also, since individual responses will be aggregated to the unit level, a higher response rate is more representative of the unit. Units that achieve a 50% response rate will receive $100. Units that achieve an 80% response rate will receive $200.

If you have any questions, please contact me either via email solomn@mainehealth.org or phone 662-1544.

I know that your days are very busy. Thank you very much for taking the time to participate in my study. I believe the results will offer new ways to improve the use of evidence in practice.

Sincerely,

Nan

Nan M. Solomons, MS

APPENDIX D

WEEKLY PARTICIPATION RATE: UNITS

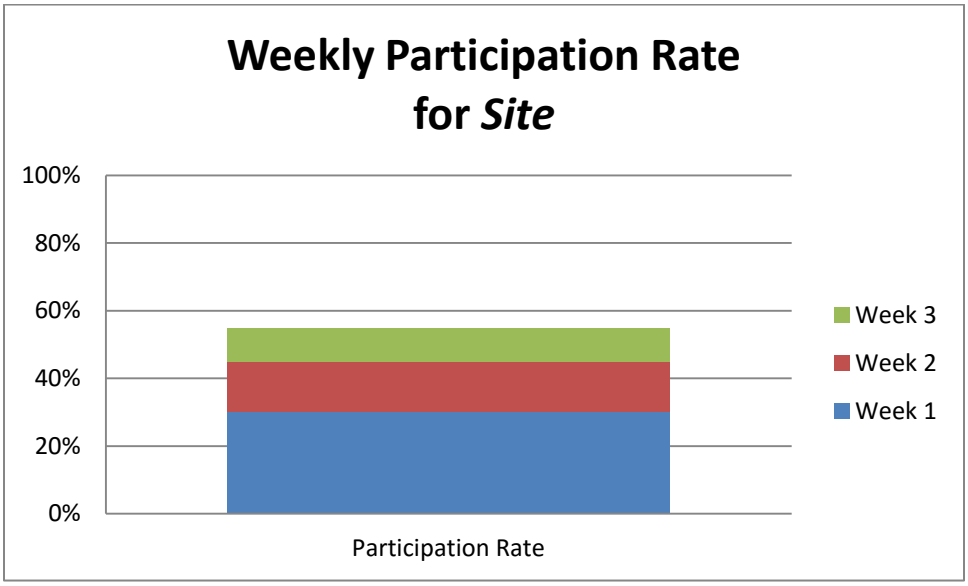
Dear Leader:

Thank you for your continued participation in my doctoral research on the role of communication and relationship on adherence to evidence-based practice. This is the Xth week of the 30 day data collection period. Based on the number of collected surveys I have received (online and paper), the participation rate on your unit is XX%. The bar chart embedded in this email shows your unit's cumulative weekly participation rate. Units that have 50% participation at the end of the data collection period will receive $100. Units that have 80% participation at the end of the data collection period will receive $200.

Sincerely,

Nan

Nan M. Solomons, MS
662-1544
solomn@mainehealth.org



APPENDIX E

INSTITUTIONAL REVIEW BOARD APPROVALS

IRB # 4348

Maine Medical Center

MaineHealth

To: Nan Solomons M.S.
MaineHealth
Center for Quality and Safety
39 Forest Ave
Portland, ME 04101
solonn@mainehealth.org

Re: Notice of Expedited Amendment Approval
IRB # 4348 Exploring the associations among nursing and discharge planning staff relationships, communication and adherence to evidence-based transitional care activities

Date: 9/9/2014

This is to inform you that the Maine Medical Center IRB reviewed your amendment request for the above captioned study. We understand that you are requesting the following change: Adherence rate data for the identified tasks within the care transition bundle will also be collected for the month preceding data collection and the month after data collection. You hypothesize that additional data collection will provide baseline and post survey measures of adherence. Upon review of this amendment an Expedited approval was granted on 09/09/2014 according to federal regulation 45 CFR 46.110 (b)(2).

Please be aware that the IRB will be notified of this action at its meeting on **09/30/2014.**

The approval period for this study ends on **03/10/2015.** Any additional modifications in the research protocol, study sites' personnel, or consent form during this time period must first be reviewed and approved by the IRB.

Please feel free to call our office if you have any questions (Research Compliance Office, 207-396-8268).

Jan Trott CIP
Research Compliance Officer

Copy: File

ST. MARY'S
REGIONAL MEDICAL CENTER

INSTITUTIONAL REVIEW BOARD
93 Campus Ave.
Lewiston, Maine 04243-0291
Tel # 207-777-8388 Fax# 207-777-8379
IRB # 00002535

To: Nan Solomons, M.S.
Maine Health
Center for Quality and Safety
39 Forest Ave.
Portland, ME 04101

SMRMC IRB Assigned #1102

Title:

Exploring the associations among nursing and discharge planning staff relationships, communication and adherence to evidence-based transitional care activities.

Request Type: Initial approval

The request has been reviewed and approved by the SMRMC IRB:

Approval Date: March 31, 2014 by expedited review.

Marc F. Boissonneault, R.Ph., MSB
IRB Chair

MaineGeneral Medical Center
35 Medical Center Parkway
Augusta, Maine 04330
207-626-1000

www.mainegeneral.org

February 25, 2014

Nan Solomons, MS
Data Analyst III
MaineHealth Center for Quality and Safety
110 Free Street
Portland, ME 04104

Re: "The Impact of Nurses' Social Networks on Communication and Adherence to Evidence-Based Transitional Care Activities"

Dear Ms. Solomons:

Rochelle Findlay has reviewed your proposal and we believe that this qualifies for expedited review and approval. I am granting you permission to commence the study effective February 25, 2014. The IRB meets again in its entirety on March 14, 2014, and I will update the full IRB committee at that time.

Please keep in mind that you are obligated to notify the IRB should you desire to make any changes to your protocol, should any unexpected events occur as your investigation proceeds and to either seek annual renewals to maintain approval or to terminate the project.

We wish you the best on this research project and look forward to hearing from you in the future.

Regards,

Stacy Diaz, MD, FAAFP, FACEP
Chairman of Institutional Review Board
MaineGeneral Health

ASU Knowledge Enterprise Development

APPROVAL: EXPEDITED REVIEW

Gerri Lamb
CONHI - Research Faculty and Staff
-
Gerri.Lamb@asu.edu

Dear Gerri Lamb:

On 3/24/2014 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Exploring the associations among nursing and discharge planning staff relationships, communication and adherence to evidence-based transitional care activities
Investigator:	Gerri Lamb
IRB ID:	STUDY00000814
Category of review:	(7)(b) Social science methods, (7)(a) Behavioral research
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• HRP-503aSolomons PROTOCOL (1).docx, Category: IRB Protocol; • Research Plan Submitted to Maine IRBs, Category: IRB Protocol; • Maine General IRB Approval Letter, Category: Other (to reflect anything not captured above); • Maine Medical Center IRB Approval, Category: Other (to reflect anything not captured above);

The IRB approved the protocol from 3/24/2014 to 3/23/2015 inclusive. Three weeks before 3/23/2015 you are to submit a completed "FORM: Continuing Review (HRP-212)" and required attachments to request continuing approval or closure.

APPENDIX F

STAFF PARTICIPATION RATES BY ROLE AND SHIFT

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
1	11	43	15	35%							
					Day	4	10%	2	1	0	0%
					Night	4	10%	0	2	1	3%
					Not Specified	0	0%	0	1	0	0%
					Total	8	21%	2	4	1	3%

Note: The number of distributed surveys including the nurse manager and 3 discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (39).

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
1	12	70	27	39%							
					Day	6	9%	2	0	3	5%
					Night	7	11%	0	0	6	9%
					Not Specified	0	0%	0	1	2	3%
					Total	13	20%	2	4	11	17%

Note: The number of distributed surveys including the nurse manager and 3 discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (66).

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
1	13	76	35	46%							
					Day	12	16%	1	3	6	8%
					Night	6	8%	0	2	3	4%
					Not Specified	0	0%	0	1	1	1%
					Total	18	25%	1	6	10	14%

Note: The number of distributed surveys including the nurse manager and 2 discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (73).

Unit Participation Rate by Role and Shift

						Nurse	Discharge planner	Supervisor	CNA
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	Count	Count	Count
1	Home Care	5	4	80%					
					Day	2	1	0	0
					Night	0	0	0	0
					Not Specified	1	0	0	0
					Total	3	1	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
1	Long-term Care	16	3	19%					
					Day	0	2	0	0
					Night	0	0	1	0
					Not Specified	0	0	0	0
					Total	0	2	1	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
2	21	40	13	33%							
					Day	4	11%	1	1	0	0%
					Night	5	14%	0	0	2	6%
					Not Specified	0	0%	0	0	0	0%
					Total	9	25%	1	1	2	6%

Note: The number of distributed surveys including the nurse manager and 3 discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (33).

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
2	22	35	15	43%							
					Day	5	16%	3	1	1	3%
					Night	4	13%	0	0	1	3%
					Not Specified	0	0%	0	0	0	0%
					Total	9	29%	3	1	2	6%

Note: The number of distributed surveys including the nurse manager and 2 discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (73).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
2	Home Care	3	2	67%					
					Day	2	0	0	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	2	0	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
2	Long-term Care	7	3	43%					
					Day	2	0	0	0
					Night	1	0	0	0
					Not Specified	0	0	0	0
					Total	3	0	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
3	31	36	24	67%							
					Day	6	19%	0	1	6	19%
					Night	6	19%	0	0	4	13%
					Not Specified	0	0%	0	0	1	3%
					Total	12	39%	0	1	11	35%

Note: The number of distributed surveys including the nurse manager and 4discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (31).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
3	Home Care	15	9	60%					
					Day	7	1	0	0
					Night	0	0	0	0
					Not Specified	1	0	0	0
					Total	8	1	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

						Nurse	Discharge planner	Supervisor	CNA
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	Count	Count	Count
3	Long-term Care	13	12	92%					
					Day	7	0	0	0
					Night	4	0	0	0
					Not Specified	0	0	1	0
					Total	11	0	1	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
4	41	71	38	54%							
					Day	12	18%	1	1	6	9%
					Night	13	19%	0	0	4	6%
					Not Specified	1	1%	0	0	0	0%
					Total	26	39%	1	1	10	15%

Note: The number of distributed surveys including the nurse manager and 3discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (67).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
4	Home Care	2	2	100%					
					Day	1	1	0	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	1	1	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
4	Long-term Care	15	14	100%					
					Day	3	2	5	0
					Night	3	0	1	0
					Not Specified	0	0	0	0
					Total	6	2	6	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse		Discharge planner	Supervisor	CNA	
						Count	%	Count	Count	Count	%
6	61	32	25	78%							
					Day	9	32%	2	0	7	25%
					Night	6	21%	0	0	1	4%
					Not Specified	0	0%	0	0	0	0%
					Total	15	54%	2	0	8	29%

Note: The number of distributed surveys including the nurse manager and 2.5discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (28).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse		Discharge planner	Supervisor	CNA	
						Count	%	Count	Count	Count	%
6	62	32	17	53%							
					Day	7	25%	0	0	4	14%
					Night	5	18%	0	0	1	4%
					Not Specified	0	0%	0	0	0	0%
					Total	12	43%	0	0	5	18%

Note: The number of distributed surveys including the nurse manager and 2.5discharge planning staff.
The response rate is based on the number of surveys distributed to nursing staff (28).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
6	Home Care	2	1	50%					
					Day	1	0	0	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	1	0	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
6	Long-term Care	24	8	33%					
					Day	7	0	1	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	7	0	1	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

						Nurse		Discharge planner	Supervisor	CNA	
Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Count	%	Count	Count	Count	%
7	71	104	70	67%							
					Day	20	22%	9	1	4	4%
					Night	23	25%	0	0	12	13%
					Not Specified	1	1%	0	0	0	0%
					Total	44	48%	9	1	16	17%

Note: The number of distributed surveys including the nurse manager and 11discharge planning staff. The response rate is based on the number of surveys distributed to nursing staff (92).

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
7	Home Care	4	4	100%					
					Day	3	1	0	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	3	1	0	0

Note: Response rates were not calculated by role due to the small sample size.

Unit Participation Rate by Role and Shift

Hospital	Unit	Surveys distributed	Surveys returned	Response rate	Unit/ Shift	Nurse Count	Discharge planner Count	Supervisor Count	CNA Count
7	Long-term Care	4	1	25%					
					Day	1	0	0	0
					Night	0	0	0	0
					Not Specified	0	0	0	0
					Total	1	0	0	0

Note: Response rates were not calculated by role due to the small sample size.