Coordinating Care: A Relational Systems Approach

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Dedication

To my care guides in life,
my parents, Sungyun Lee and Hyukim Kwon
and God, my heavenly Father

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Care coordination has been identified as one of the key strategies to alleviate problems of quality and costs in the healthcare system (McDonald et al., 2007; IOM, 2001). Care coordination strategies can be found in multidisciplinary teams, care management, medication management, and the patient centered medical home (PCMH). Care coordination activities encompass monitoring and follow up, assessing and responding to patients' needs, supporting transitions of care, developing care plans, connecting for community resources, aligning patient needs and preferences with clinically appropriate and effective care to communicating and sharing knowledge, determining roles, responsibility and accountability, and responding to changes in patients' needs, clinical practice, or system transformation.

While approaches to coordinating care vary greatly, care coordination aims to deliver the right health care services in the right order, at the right time, in the right setting (McDonald et al., 2007). Care coordination entails deliberately organizing the people, knowledge, resources, and activities required to deliver the care. Failing to do so leads to inaccurate transmission of information, insufficient communication, improper care, and inadequate attention to the patient's needs (Cummins et al., 1980; Gandhi et al., 2000). Poorly coordinated care yields confusion in who takes responsibility in which aspect of the care, poor outcomes such as medication errors, duplication or omission of procedures, avoidable hospitalizations and emergency department visits, suboptimal patient

experiences and others (Gandhi et al., 2000; Kripalani et al., 2007). Uncoordinated care presents risk and dissatisfaction for patients and providers as well as unnecessary waste and cost to the providers and the health care system (McDonald et al., 2007).

1.2 Statement of Purpose

This dissertation focuses on the coordination mechanism and processes associated with interdisciplinary health care teams. The motivation of this dissertation comes from integrating the idea of using lay health care extenders, care guides, to form a tight care team within the primary care clinics. An increasing adoption of teams is observed in many care coordination efforts. Teams are interdependent inter-occupational groups of individuals sharing relevant knowledge and aligning tasks to achieve a shared goal of providing better care to patients. Their subtask may dissolve or change over the patient's trajectories of care, but the overall task of managing a patient's health will be sustained at the systems level. Thus, within and across teams, interactions may be complex and saturated, but governing rules for the action and the interaction for coordinating care emulate the principles of coordination in general. This dissertation examines care coordination based on theoretical constructs of coordination from organizational science and investigates further the mechanisms of coordinating processes relevant to health care settings.

Specifically, this dissertation aims to understand the context of care coordination with attention to relationship as a primary vehicle to carry out the coordinating activities. There is growing interest in the role that relationship plays in the care process. Inquiries

attesting to the benefits of effective care coordination in health care span across the various settings, including intensive care (Shortell et al., 1994), surgical inpatient care (Young et al., 1997), and outpatient care as well as caring for cancer patients (Bickell and Young, 2001). Understanding the relational mechanisms for influencing primary care teams and the relevant coordinating processes will be instrumental in identifying the elements that improve care coordination efforts in our health care system. This dissertation theorizes and empirically illustrates that the team is an organizational design to cultivate relationships, thus advancing the understanding of the role of relational systems in coordinating care.

A team is defined as a "distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform (Salas et al., 1992)". A team is an organization design to cultivate relationships. It brings together a set of people to carry out an organizational task. The configuration of a team specifies the structures and the complexity of interpersonal connections and the communication network.

In many cases, the concept of coordination is embedded in the definition of a team. Coordination requires interaction, sharing of information, and joint decision making about the goals and responsibilities among the team members. Team is much incorporated in health care. Therefore, success of coordination is dependent upon employing effective teamwork.

Understanding coordination delivered by teams, especially teams attuned to enhance the relationship as a means for more effective work with patients, is necessary. A care guide model of care is one strategy to support greater coordination among health care teams. The care guide approach designates a layperson, a care guide, who works with physicians and nurses to assist patients with self-management. A strength of using lay care guide is that individuals who are similar to patient, who have time to give attention and provide support for patient increase the likelihood of forming a relationship with patients. By removing the boundaries to efficient and effective communication and shared goals, more of the focus can be placed on providing care, and perhaps even on providing care in a way that is more personalized and more responsive to the patients' needs. The theory of relational coordination may provide a unique lens to understand the relational dynamics within this team care model. This dissertation posits the utility of a systems approach to health care delivery through the concept of relational coordination –mutually reinforcing a process of communication that is frequent, timely, accurate, and focused on problem solving and of high quality relationships, that is, having shared knowledge, shared goals, and mutual respect (Gittell, 2010). The theory takes on the relational approaches to the coordination of work: arguing that coordination is not just the management of interdependence between tasks, but it's also the management of interdependence between the people who perform those tasks. The theory provides a framework for measuring and analyzing the strength and quality of bonds formed in the relational triad and its influence on managing chronic illness. Strengthened relational coordination will likely improve quality and efficiency in the delivery of care (Gittell, 2002; Gittell, 2012). This

dissertation conceptualizes chronic care as a coordination work and relational coordination as the organizational climate affecting organizational processes. It investigates the mechanisms influenced by the strength and the quality of the relationships that lead to effectiveness of team-based care delivery in chronic disease management. Specifically, I investigate the influence of care guides model of care, continuity of care, and relational coordination on adherence to guideline-recommended care.

Building on the theoretical framework that communication and relationship are fundamental aspects of positive organizational change (Gittell 2012, Gittell, 2002), I evaluate the relationship between the care guide team model and its performance on adherence to guideline recommended care, as moderated by relational coordination and mediated by continuity of care.

The focus of this dissertation is set on care coordination carried out by health care teams in primary care settings, designed to support chronic disease management. This limited scope is necessary, because the composition and characteristics of the team, nature of the work, and goals of the team will vary greatly according to the setting and the context of care delivery.

Primary care teams are relatively stable, ongoing work groups. Accordingly, the exchanges between the care team members are much more reciprocal compare to other types of care teams, such as emergency response teams or surgical teams. The primary

care teams focus on delivery of chronic care and perform multi-activity tasks with a broad set of goals. Work activities are divided and assigned through both the hierarchical lines of work as well as the networks of interpersonal relationships. While team member roles clearly outline responsibilities, high degrees of uncertainty are expected because the nature of the work of patient care is a highly interdependent, complex information processing activity.

Many care coordination activities in areas of chronic disease management regard a patient as a member of the team and a key information holder. Not only is active participation expected of patients, it is also critical to managing their conditions. This alters the landscape of coordination greatly. Inclusion of a patient as an active member of the care team results in interdependencies that occur beyond organizational boundaries, as patients are external members to the organization. Simply put, a client with an active voice and action affects organizational performance. This conceptualization is also the core of the patient centered approach to care. Thus, reconfiguration of the team with inclusion of the patient will require the care team to revisit contingencies faced within patient care, subsequently readjust division of behavioral, cognitive, and relational work, and manage the work processes.

Examining a relational approach to coordinating care is important. The care guide model of care is a means to improving relations in many complex interdependent work processes that are critical to improving the quality of patient care. A relationship-based approach to care coordination is possible through the adoption and integration of

mechanisms that support interaction and information sharing. Coordination works through the interactions of individuals who bring knowledge and work together in a situation that presents both opportunities and constraints. This dissertation addresses how multiple contextual factors in organizations strengthen or attenuate the approach to improve quality of care delivery through a team-based, goal-oriented, relationship-focused model of care. The combined effect of relational coordination and continuity of care on team based care coordination will provide empirical evidence about its relative effectiveness in providing care that adheres to guideline recommendations.

CHAPTER TWO: BACKGROUND AND LITERATURE REVIEW

2.1 Primer on Primary Care

2.1.1 What is Primary Care?

Primary care is central to the U.S. health system (Starfield et al., 2005). Starfield (1998) identifies four main features of primary care as i) a first contact for any new health issue or need, ii) long-term, person-focused care, iii) comprehensive care for most health needs, and iv) coordination of care when it must be received elsewhere (i.e., with a specialist). Primary care has been a foundation of our health care. With recent reforms and discussions around patient centered medical homes and accountable care organizations as well as aging populations and increasing prevalence of chronic illness, attention to primary care has never been stronger.

2.1.2 Problems in Primary Care

However, primary care has become increasingly complex, specialized, and fragmented. Patients with chronic, complex health needs often are overwhelmed by the challenges of navigating between disparate settings, aggravated by an inadequate and inaccurate flow of information across the expansive trajectories of care. For example, in a given year, a typical Medicare beneficiary receives care from two primary care physicians, and five specialists, in addition to care received in diagnostic, pharmacy, and other services (Bodenheimer, 2008). Dispersion of care was more prevalent for patients with chronic disease, and to a greater extent if patients had multiple chronic conditions (Pham et al., 2007).

Many conceptual frameworks have been proposed in an effort to address the problems of coordination that primary care is facing. For example, patient-centeredness is one of the six aims that the Institute of Medicine recommends in its seminal work *Crossing the Quality Chasm* (2001). Patient-centered approaches promote a) first contact of care, b) coordinated care, c) comprehensive care, and d) sustained personal relationships (Nutting et al., 2011). In addition, the Federal Patient Protection and Affordable Care Act of 2010's, as well as the promotion of accountable care organizations and medical homes, all contain similar provisions: patient-centeredness, care coordination, and relationship focused care. These efforts are an integral part of redesigning the U.S. healthcare system and strengthening primary care.

2.1.3 Barriers to Care

Evidence suggests patient-centered care can improve health outcomes (Center for the Advancement of Health, 1996). However, complexities of the current healthcare system often displace the patient or the patient's family members from the issues of coordination, care continuity, and quality of a patient's medical care. With a growing aging population with multiple chronic illness and increasingly complex delivery settings, coordination can be challenging at the patient, the practice, and the system level.

Patients sometimes lack the ability to advocate for their needs and preferences and navigate through the complex healthcare system (Berger et al., 2008). For a patient with multiple chronic illnesses, the task may be beyond the capabilities of the patient and/or

family members, leaving patients confused, passive, and apathetic about their own care. Patients who are not engaged in their care may be more dissatisfied and experience poorer health outcomes (Bodenheimer et al., 2002a; Bodenheimer et al., 2002b).

From the patient's perspective, barriers to care go beyond the clinical boundaries. Logistical barriers, such as distance, transportation, and language issues, or financial barriers, such as uninsurance, underinsurance, burdens of out-of-pocket cost or medication cost, diminish the effective management of chronic illness (Horton, 2005; Druss et al., 2001).

Meanwhile, a shortage of physicians practicing primary care continues to present challenges for the system. Some characteristics of primary care, including stress, inefficiencies, excessive work demand and an income gap compared to other specialties, and may drive doctors away from practicing in primary care (Lakhan and Laird, 2009; ACP, 2006; Bodenheimer, 2006; Garibaldi et al., 2005; Anderson and Horvath, 2004). The shortage of doctors practicing primary care medicine exacerbates the barriers to care as increased patient volume compromises the capacity and effectiveness of delivery of care. Usual patient encounters last 18 to 21 minutes on average (Mechanic et al., 2001). Lack of adequate time during office visits is a much-cited barrier to delivering appropriate care (Ostbye et al., 2005). Consequently, conventional ambulatory care is characterized as episodic, focusing on illness and cure, where the patient-doctor relationship is limited to the moment of consultation.

Poor communication among providers is another fundamental barrier to effective care delivery. Traditionally, physicians have enjoyed autonomy in making decisions pertinent to care. However, health care today is delivered not only by doctors, but also nurses, physician assistants, physical therapists, psychologists, community health workers, social workers, and many others. Increasingly, the system no longer allows physicians to work alone. Providers are expected to integrate their work efforts across a wide span of professionals, information systems, and organizational boundaries. Doctors experience communication barriers, not only with other providers and staff, but also with the patients and their caregivers. In addition, clinicians may not naturally gravitate towards patient-centeredness when delivering care. They are trained to provide evidence based, clinically effective care in a cost-effective way. Physicians often display frustration and stress associated with communicating and relating to patients. Their perceived inability to bring about positive behavior change can undermine efforts to manage chronic illness (Rosal et al., 2004; Mosca et al., 2005).

With high patient volumes and limited primary care resources, care coordination activities are often fiscally strenuous. Also, the current reimbursement structure lacks incentives for chronic disease management or care coordination efforts. For example, Rubinstein (2008) notes that the fee-for-service reimbursement system does not reward preventive care. Government, at the state and federal level, as well as the private sector, from delivery systems to insurance providers, are exploring ways to reform the payment system, but to date the results have been inconclusive.

2.2 Care Coordination

Because of these considerations, there has been a drive for exploring various ways to improve care coordination. Efforts to coordinate care take many forms, including interdisciplinary health care teams, assertive community treatment (Latimer, 1999; Marshall and Lockwood, 2000), collaborative care (Craven and Bland, 2006), integrated programs (Jeffery et al., 2000; Briggs and Garner, 2006; Johri et al., 2003), shared care (Greenhalgh, 1994), disease management (Krause, 2005; Yu et al., 2006; McAllister et al., 2009), and case management (Ziguras and Stuart, 2000; Norris et al., 2002).

Care coordination interventions target different types of diseases and conditions at various stages of care. For example, medication management may focus on patient education upon discharge and monitoring, whereas an emergency response teams may be used to prevent adverse events during surgery. Interventions to coordinate care also can vary by the patient type and by the care settings. For example, caring for the elderly may involve coordination between the health care system, community resources, and nursing homes, while caring for adolescents requires a transition of care from pediatric to adult care. Care coordination can be carried out by the government as well as by the private sector. Medicare demonstration projects contain care coordination strategies initiated by the public sector and care management programs run by insurance companies exemplify such effort ongoing in the private sector (Mathematica Policy Research, 2004; McDonald et al., 2007). The purpose for coordinating care can range from reducing the cost of care or medical errors to improving the quality of care and patient experience.

2.2.1 Elements of Care Coordination

Definitions of care coordination and its purpose vary greatly and are much dependent upon the setting and context of the care delivery. Notwithstanding, there are common elements:

> i) Care coordination has a purpose or goal of facilitating appropriate delivery of health care services,
> ii) Care coordination involves numerous participants,
> iii) Coordination is necessary when participants are interdependent in order to carry out disparate tasks in a patient's care,
> iv) Participants rely on exchange of information to integrate care activities,
> v) In order to manage all required patient care activities in a coordinated way, each participant needs adequate knowledge about their own and others' roles and available resources (McDonald et al., 2007).

Thus, the concept of coordination is embedded in the definition of a team. Coordination requires interaction, sharing of information, and integration of tasks and shared responsibility for a common goal between the team members. Mosser and Begun (2013) define the characteristics of the team as having i) shared team goal, ii) shared responsibility for achieving the goal, iii) defined membership, iv) authority for taking action to achieve the goal, v) interdependency of members, vi) absence of independent sub-groups, and vii) accountability to the larger organization. The composition of teams varies depending on the size (large vs small), level of cohesion (centralized vs dispersed), proximity (face-to-face vs virtual) and task type (focused and brief vs broad and over time).

Teams deliver a greater proportion of health care today (Mosser and Begun, 2013). Evidence suggests teams are effective in health care across diverse settings (Bosch et al., 2009; Lemieux-Charles and McGuire, 2006), including inpatient teams (Baggs et al., 1999; Gums et al., 1999), geriatric teams (Banerjee et al., 1996; Hogan and Fox, 1990; Rabow et al., 2004), emergency response teams (Bellomo et al., 2004), and cancer care teams (Kesson et al., 2012). Similarly, depending on the disease, setting, and patient type, care team members can include doctors, nurses, psychologists, pharmacists, as well as social workers, therapists, dietitians, translator, transportation workers, or family members. Teamwork is ubiquitous in healthcare. Therefore, the success of coordination is closely associated with employing effective teamwork.

Team-based coordination in chronic disease management is now a central theme in the discourse on primary care redesign (Bodenheimer, 2008; Wagner, 2000; Grumbach and Bodenheimer, 2004). Efforts are being made in developing team care models to help patients find support from an individual who assists patients through the process of care. One approach is to include allied health professionals, such as physician assistants, nurse practitioners, and lay individuals in the health care team.

Often cited barriers to care are at the basic level; non-clinically trained people can address logistical barriers and system navigation challenges (Kennedy et al., 2007; Schwartz and Sendor, 1999; Peters-Klimm et al., 2007). The literature also suggests that means to encourage and support patient self-management should be inexpensive and widely available. There is also evidence that involvement of trained lay persons on teams

can effectively increase patients' self-efficacy while being accepted by other members of the teams, both patients and clinical professionals (Von Korff et al., 1998).

Use of lay individuals as members of primary care teams to focus on care coordination was first introduced in the form of a patient navigator to address racial disparities in the diagnosis and care for cancer patient (Freeman, 2004; Dohan and Schrag, 2005). The approach has been adopted in chronic disease management with varying job titles and role definitions, such as 'care coordinator', 'health advisor', 'health coach', 'promotora', 'comrade', and 'ambassador' (McCullough et al., 1998; Moran, 2013; Fischer et al., 2007). While the navigators for cancer patients focus mostly on logistical and systemic barriers, similar positions in chronic disease management put more emphasis on delivering comprehensive disease education, assuring information exchange, and promoting lifestyle change or behavior modification as well as incorporating services that address the patient's non-medical needs that may affect health.

Adding lay health workers to the primary care workforce is a change in organizational structures that entails reconfiguring the boundaries of care team and redefining the scope of practice for the members of the care team. Much discussion, evaluation, and insight have produced a generalized care model known as the teamlet model, in which a non-clinical staff are used to extend care beyond the standard fifteen minute physician-patient encounter through offering pre- and post-visit sessions and by providing follow-up care between clinic visits via routine contact with the patient (Bodenheimer and Laing, 2007). Efforts to increase the amount of teamwork involved in health care are challenged by

patient volume, high uncertainty, and time and resource constraints. The goal of the teamlet model is to reduce physician workload while increasing the quality of attention that patients receive.

Bodenheimer identifies elements of an effective clinical team as: i) having goals that are unambiguous and measurable; ii) presence of clinical and administrative systems that support the work of the team; iii) clear division of labor; iv) training; and v) solid communication framework and processes (Bodenheimer and Laing, 2007). Similarly, Mitchell et al.(2012) observed that well functioning health care teams have shared goals, clear roles, mutual trust, effective communication, and measurable processes and outcomes.

The elements of effective clinical team parallel characteristics for competent care coordination. Common elements of coordination in health care settings include clearly identifying purpose and goal, involving multiple participants, assigning specialized member roles and responsibilities, utilizing task-relevant knowledge, exchanging information, and working interdependently (McDonald et al., 2007). In fact, these common elements of coordination are not unique to health care settings. Rather, one can view care coordination as a subset of coordination, an institutional example. Thus, in explicating care coordination, I start by defining coordination in general, grounded in organizational theory.

2.3 Theoretical Underpinnings of Coordination

2.3.1 Definition of Coordination

Coordination is integral to successfully carrying out the work of the organization. Malone and Crowston (1990) defined coordination as "managing interdependencies between activities performed to achieve a goal (p.361)". Quinn and Dutton (2005) defined coordination as "the process through which people arrange actions in ways that they believe will enable them to accomplish their goals (p.36)". Argote (1982) viewed coordination as "fitting together the activities of organization members" and the need for coordination originates from the "interdepdent nature of the activities that organizational members perform (p.423)". Faraj and Xiao (2006) state, "coordination is about the integration of organizational work under conditions of task interdependence and uncertainty (p.1156), and define coordination as a "temporally unfolding and contextualized process of input regulation and interaction articulation to realize a collective performance (p.1157).

Table 1 provides selected definitions of coordination. In reviewing the multitude of outlooks on coordination found across disciplines, Okhuysen and Bechky (2009) identified three commonalities: "1) people work collectively; 2) the work is interdependent; and 3) a goal, task, or piece of work is achieved (p.469)".

Faraj and Xiao (2006)	"the integration of organizational work under conditions of task interdependence and uncertainty (p.1156)" "temporally unfolding and contextualized process of input regulation and interaction articulation to realize a collective performance (p.1157)"
Argote (1982)	"fitting together the activities of organization members and the need for (coordination) arise from the interdependent nature of the activities that organizational members perform (p.423)"
Quinn and Dutton (2005)	"the process through which people arrange actions in ways that they believe will enable them to accomplish their goals (p.36)"
Malone and Crowston (1990)	"managing interdependencies between activities performed to achieve a goal (p.361)"
NSF (1989)	"the joint efforts of independent communicating actors towards mutually defined goals"
Singh (1992)	"the integration and harmonious adjustment of individual work efforts towards the accomplishment of a larger goal"
Holt (1988)	"Composing purposeful actions into larger purposeful wholes"
Reezigt (1995)	"Establishing attunement between tasks with the purpose of accomplishing that the execution of separate tasks is timely, in the right order and of the right quantity"
Healey et al.(2004)	"Performance enhancement of function through managing and timing activities and tasks"
Lawrence and Lorsch (1969)	"the integrative devices for interconnecting differentiated sub-units"

Table 1. Definitions of Coordination

2.3.2 Emergence of Coordination

Why do organizations coordinate? Or why do they need to coordinate? Thompson (1967) stipulated that, in the context of interdependence, the organization coordinates in order to maximize the potential of organizational performance or functioning. Coordination allows organizations to leverage their potential to produce high quality work through managing interdependencies (Faraj and Sproull, 2000). Well-performing coordinating

activities will enhance the efficiency and effectiveness of organizational practices (Gittell, 2002).

Coordination operates around differentiation and integration (Lawrence and Lorsch, 1967; Heath and Staudenmayer, 2000; Bailey et al., 2010). Complex tasks are divided into subtasks. Depending on the levels of differentiation, the corresponding integrative tool can be employed to bring together subtasks, skills, or technologies. As Bailey and his colleagues point out (2010), finding the optimal balance between differentiation and integration for particular work situation -'minding the gaps'- is critical and is the factor that defines high performing, high functioning organizations.

If coordination augments the quality of work and the level of output, then perhaps every organization should put coordination as a high priority work process. Although useful, coordination can be costly and may be unnecessary depending on the circumstances. Coordination demands individuals do extra work, go beyond their individual task, and make additional effort to communicate in order to align tasks and accomplish organizational goals in concerted action. When tasks are not interdependent, coordination effort is unnecessary (Van de Van et al., 1976). When the coordinating activities, processes, or mechanisms do not fit the gaps between differentiation and integration for a given task, the cost of coordination in the form of inadequate communication or insufficient delivery across the gaps between people, tools, and tasks may be greater than its benefits (Heath and Staudenmayer, 2000). Along with process loss, failure to coordinate will result in redundant work, suboptimal allocation of

resources and use of skills, delays in completion of the task, and incompatibilities between subtasks inapt for integration.

2.3.3 Elements of Coordination

The scope of this research is limited to the consideration of coordination in granular small groups and teams within the same unit in an organization, and excludes coordination at other levels, such as macro inter-organizational or temporal team coordination that involves different units within organizations (Hackman, 1987). Teams are the primary mechanisms for accomplishing organizational tasks (Van de Ven et al., 1976).

Coordination is necessary when complex tasks are divided into subtasks: the amount of resources, including that of labor and skill, to carry out a task may exceed on individual's skill set or knowledge and information. From the individual-based perspective, such as Krackhardt and Carley's PCANS model (1998), interdependencies are realized under the domains of independent individuals, tasks, and resources. Their approach of formalizing dependencies between distinct domain elements may be useful in understanding interdependencies and coordination at the individual level, but leaves room for useful and practical application in the team settings, as elements of coordination are considered at an individual level. "Groups are inherently different from individual performing tasks, because group members need to coordinate (Kraut et al., 2005)".

While variables at the individual level are acknowledged, the analytic framework proposed in Figure 1 extends Krackhardt and Carley's PCANS model (1998) to the team

level, by adopting research on expertise coordination (Faraj and Sproull, 2000), affective and cognitive integration (Cronin et al., 2011), and behavioral, cognitive, affective dimensions of social exchange (Lawler et al., 2008). Figure 1 provides domains in coordination more attentive to the functioning of the team. To add clarity and establish common ground on which coordination mechanisms can be analyzed, I devise a taxonomy of coordination modes, three distinct areas that may be useful in team contexts. In order to carry out team tasks or goals, organizations divide them into sub-components and rely on affectual, behavioral, and cognitive resources that are possessed by members of the team.

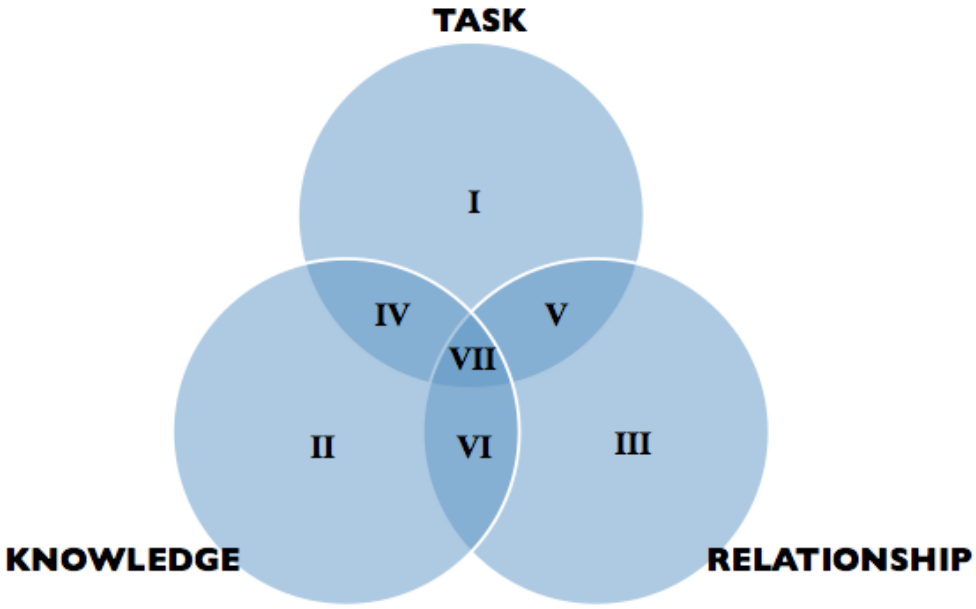

Figure 1. Domains of Team Coordination

Coordination manifests as the coordination of tasks, knowledge, and relationships (Figure 1). Coordination of tasks relates to interdependent work activities. For example,

production in an assembly line requires integrating highly divisible tasks (Crowston, 1997; Malone and Crowston, 1994). Coordination of knowledge focuses on information processing activity related to carrying out the work as well as organizational action. For instance, the work of a brainstorming group, where managing differentiated knowledge from division of knowledge responsibilities, exemplifies of knowledge coordination (Faraj and Sproull, 2000). Coordination of relationships pertains to the work governed through networks of relationships specified by organizational design. This type of coordination activity will rely heavily on interpersonal processes through interactions and communications. For example, Bechky's ethnographic study (2006) observed film set crews, isolated on location, develop a small society and become involved in social activities outside of work duties. While team coordination is comprised of domains of tasks, knowledge, and relationships, often times these domains are not isolated elements, but interdependent entities.

In most organizations, coordination is actualized in some combination of these distinct dimensions, rather than the isolated integration in task, knowledge, and relationship. For example, during the surgical process, a surgeon, an anesthesiologist, and operating room nurses carry out specific duties delegated to them according to their specialized clinical knowledge. Domain IV (task + knowledge) exhibits cognitively demanding tasks, where members' expert knowledge, skills, and abilities are essential to execute tasks (Larson, 2010). Individual members of the organization hold responsibilities that are necessary to carry out organizational functions. Familiarity with these member roles and their task responsibilities comprises another domain in team coordination (domain VI: knowledge+

relationship) Sometimes, identification of a relational expert –who has access to content expert or specialized knowledge, recognition of who is responsible for what subtask and who has networks to bring them together- is essential in coordinating work. More complex organizations will require integration of all three types of coordination. The relationship between team members affects task completion and knowledge sharing behavior within the team.

This identification of elements of team coordination (Figure 1) helps framing of organizational design. This framework will be useful for studying not only the 'how' of the coordination, its mechanisms and processes, but also the 'what' of the coordination, of its elements and content, which will have a practical implication in designing the organizational structure to divide and merge back the physical, cognitive, and relational labor to efficiently accomplish organizational goals.

Coordination mechanisms are purposeful organizational processes that enable various types of coordination as depicted in Figure 1. Coordination is contingent upon the type of activities liaised and the demands that an organization confronts.

2.3.4 Context of Coordination

The need for coordination arises from two organizational challenges. They are interdependence (Thompson, 1967; Espinosa et al., 2004, Faraj and Xiao, 2006) and uncertainty (Argote, 1982; Galbraith, 1974, Faraj and Xiao, 2006). Understanding these challenges helps us to recognize where the concept of coordination stems from and how

coordination mechanisms are applied in addressing the contingencies of uncertainty and interdependence. Managing interdependence is one of the key functions of an organization (Lawrence and Lorsch, 1967). An organization embeds a network of interdependence in which its parts, be it people or task, need to work together with one another to accomplish goals. Thus, interdependence is a product of organizational design, and practices of coordination are particular to the types of interdependence (Heath and Staudenmayer, 2000; Thompson, 1967).

For example, Thompson (1967) distinguished interdependence by the patterns of reliance on the performance of the other parts of the organization: 1) pooled, 2) sequential, and 3) reciprocal interdependence. Pooled interdependence is a basic form of interdependence. Under this type of interdependence, each supported part of an organization renders a discrete contribution to the functioning of an organization. If X and Y are sequentially interdependent, X must act or occur properly before Y can act. X and Y are to have reciprocal interdependence if constant exchange is required between them to carry out the task. All organizations have pooled interdependence; more complicated organizations have sequential as well as pooled interdependence; and the most complex ones portray reciprocal, sequential, and pooled interdependence (Thompson, 1967). Each type of interdependence contains increasing degrees of contingency.

Another predecessor of coordination is uncertainty. Uncertainty is experienced when there is an inability to ascertain the likelihood of future events, a lack of information about cause-effect relationships, or an inability to predict the outcomes of a decision

(Lawrence and Lorsch, 1967; Milliken, 1987). The literature suggests that technology and environment can be important sources of uncertainty (Thompson, 1967; Van de Ven et al., 1976). Adaptation to variation in technology and environment bring forth differences in patterns of coordination.

Environment pertains to the external conditions that affect or alter team functioning. Organizations cope with environmental uncertainty by defining the boundaries of coordinating activities, including organizational elements and parties involved, technology used, and output (product or service) produced (Thompson, 1967; Van de Ven et al., 1976).

Technology is another source of uncertainty. Thompson delineates technology by the types of task the organizational unit performs: 1) long-linked technology, 2) mediating technology, and 3) intensive technology. Long-linked technology is a response to uncertainty that is pertinent to sequentially interdependent work activities. Units that link the input and the output employ mediating technology. Mediating technology is employed when the organizational units link the input and the output. Intensive technology is a customized response to a diverse set of contingencies. Intensive technology depends on the nature and the variety of problems an organization faces, and combines transformation process that requires unique and specialized knowledge (Thompson, 1967).

Adaptation to varying degrees of interdependence and uncertainty determines the organizational action and organizational design to promote coordinating activities. These contingent factors are important as they provide the context for defining and configuring the mechanisms of coordination. As the level of uncertainty increases, coordination becomes more complex and challenging. As interdependencies among inter-organizational functions increase, organizations will likely increase their reliance on coordination mechanisms from formal mechanisms to informal and emergent mechanisms (Thompson, 1967).

Coordination is aimed at integrating the organizational work under the conditions of task interdependence and uncertainty (Faraj and Xiao, 2006). Table 2 juxtaposes this integrative effort with the need for and the mechanism of coordination to provide a more comprehensive understanding of how degrees of contingency shape team processes. I consider coordination needs as the desired characteristics of well-coordinated activities. Coordination mechanism refers to processes teams manipulate and employ to improve and achieve coordination. These are integrative tools needed for the division of physical, cognitive, and relational labor, tasks, skills, and other resources to accomplish organizational work. Applying the coordination mechanisms that meet the demand of coordination needs is critical in delivering intended outcomes and in doing so in an efficient and effective manner.

When tasks are low in interdependence, need for coordination is low. Individuals who are assigned to perform a given task will possess skills and access to resources needed to

accomplish the task. When tasks are low in uncertainty, there is less ambiguity, higher predictability and better control. Often, tasks are repetitive and routinized.

		Interdependence	
		Low	**High**
Uncertainty	Low	***Coordination Needs*** Little coordination, mainly to define general team setting ***Coordination Mechanisms*** Formal/structural mechanisms	***Coordination Needs*** Streamline interdependent work flows Accountability ***Coordination Mechanisms*** Clear role definitions and task assignments, planning, schedules
	High	***Coordination Needs*** Balance to reduce and adapt to unexpected changes ***Coordination Mechanisms*** Standardization, protocols Shared cognition, mutual adjustment	***Coordination Needs*** Accountability, stability, flexibility ***Coordination Mechanisms*** Constant exchanges and mutual adjustments, high reliance on both formal and emergent coordination

Table 2. Coordination and Contingency Factors

For tasks both low in interdependence and low in uncertainty, there are minimal needs for coordination. The coordinating activities can be characterized by formal structures put in place to define the general team settings. Simple methods of coordination will reduce the need for communication and negotiation by specifying appropriate, anticipated behavior and production from team members. In this relatively stable task environment, standardized operating procedures and formal, mechanistic, impersonal mode of coordination, such as rules, standards, guidelines, and routines, will suffice (Van de Ven et al., 1976; Simon, 1947).

When interdependence increases while uncertainty remains low, the need for integration between tasks, individuals, and knowledge increases. Mechanisms such as plans and schedules will be beneficial in streamlining interdependent workflows (Galbraith, 1974). Coordination is attained through organizational designs that map the timing, frequency, sequence, and pattern of interdependent tasks and team members. Depending on how complex the interdependence is, the order of the tasks and the type of connections between the tasks will require clear role definitions and task assignments. Accountability for who is responsible for what task and knowledge should be compatible with the coordination needs. Identifying the fit between the task and the coordination mechanism as well as defining responsibilities to specific roles and job functions among the team members will better support the coordination processes (Bailey et al., 2010).

Greater uncertainty increases the probability of sporadic, unpredictable outcomes. Organizations can deal with uncertainty in two ways: reduce it or cope with it. Standardization, planning, and schedules can enhance stability and predictability of team processes. These are examples of structural mechanisms. These structural coordination mechanisms are organization-specific, customized responses to reduce uncertainty and exceptions (March and Simon, 1958; Galbraith, 1974). Mutual adjustment, shared cognition, transactive memory, and common understanding are examples of emergent coordination mechanisms (Thompson, 1967; Faraj and Xiao, 2006; Lounamaa and March, 1987; Espinosa et al., 2004; Boos et al., 2011). These mechanistic coordination mechanisms allow teams to coordinate on the fly around sporadic, unpredictable, and

unexpected contingencies. Individuals can rely on the common understanding, shared expectations and assumptions, and knowledge about their own and others' roles, responsibilities, tasks, and the context, which enables team members to adjust their behavior to others' goals and actions (March and Simon, 1958; Cannon-Bowers et al., 1993; Thompson, 1967; Van de Ven et al., 1976).

When uncertainty increases while interdependence remains low, coordination aims to balance the stability or predictability of the structural mechanisms with the flexibility and emergent team processes in order to anticipate and adapt to unexpected changes in the environment (March and Simon, 1958; Thompson, 1967; Van de Ven et al., 1976).

There is greater demand for coordination when organizational tasks are highly interdependent in an uncertain environment. "(I)n such settings, …, there is a need for tight structuring, formal coordination, and hierarchical decision making to ensure a clear division of responsibilities, prompt decision processes, and timely action; but on the other hand, because of the need for rapid action and the uncertain environment, there is a competing need to rely on flexible structures, on-the-spot decision making, and informal coordination modes (Faraj and Xiao, 2006, p.1157)". Coordination in the highly interdependent and uncertain environment requires greater reliance on not only formal and explicit mechanisms, but also on interpersonal, emergent, and implicit team processes. For example, Faraj and Xiao (2006) examined coordination that occurs in a trauma center. They observed that successful coordination practices utilized both the epistemic dimensions (reliance on protocols, community of practice structuring, and team

setting) and relational (joint sense-making, cross-boundary intervention, and protocol breaking) dimensions when the task environment was unstable and highly interdependent. Formal structural mechanisms define the responsibilities and relationships between interdependent individuals: relationships, interdependence, and task progress are negotiated and communicated within the social dynamics of work, helping interdependent team members to keep track of others' coordinating activities and manage them in concerted actions (Faraj and Xiao, 2006; Thompson, 1967; Van de Ven et al., 1976; Okhuysen and Bechky, 2006).

The complexity of coordination is closely associated with the level of interdependence and uncertainty. Coordination needs vary across the degrees of differentiation and integration by gradients of contingency factors, and call for distinct coordination mechanisms for managing interdependence in the task, knowledge, and relationship dimensions, and to do so effectively and efficiently. Coordination requires readjusting team processes in the presence of changing demands and circumstances, and the amount of uncertainty they entail, while maintaining the balance between the division and integration. Team processes need to be understood in the context of coordination mechanisms that embed organizational design to manage dependency. Use of appropriate coordination processes will likely increase an organization's abilities to accomplish its goals.

2.4. Theory of Relational Coordination

Coordination mechanisms emerge through accountability (identifying who is responsible for what task), predictability (identifying where and when the elements of the task are likely to occur), and common understanding (developing shared perspectives on the goals and organizational tasks) (Okhuysen and Bechky, 2009.) In this regard, coordination is not only a work process and a structural process, but it is also a relational process. An example of coordination mechanisms that rely on the interpersonal networks of interdependence is relational coordination, a theory focused on the relational aspect required to carry out coordinating work (Grant and Parker, 2009; Gittell, 2012).

2.4.1 Conceptualizing Relational Coordination

According to relational coordination theory, coordination occurs through the interplay between two dimensions, *communication* and *relationship*, to carry out interdependent tasks. Coordination that occurs through frequent, timely, and problem-solving communication (communication dimension) supported by shared goals, shared knowledge, and mutual respect (relationship dimension) will better achieve the desired outcomes (Gittell, 2002).

Relational coordination theory emphasizes the role communication plays as a coordination mechanism itself. The importance of the communicative aspect of coordination mechanisms has been acknowledged: “the capacity of an organization to maintain a complex, highly interdependent pattern of activity is limited in parts by its capacity to handle the communication required for coordination (March and Simon,

1958)". Brown et al. (2004) suggested that coordination can be understood as a process of improving communication itself. Individuals are expected to share the knowledge they possess to carry out organizational tasks, stimulated by feedback and communication (Lewis and Herndon, 2011). Effective knowledge transfers and positive performance rely on frequent (Reagans and McEvily, 2003), accurate (Szulanski et al., 2004; Levin and Cross, 2004), timely information sharing (Zeng et al., 2008; O'Reily and Roberts, 1977), focused on problem solving (Tjosvold et al., 2005; Van de Ven et al., 1976).

Interdependent work processes, especially those requiring more complex integration, rely on the relational dimension of coordination mechanisms. Having shared goals, shared knowledge, and mutual respect among and between those who collaborate are integral for accomplishing tasks. While the communication dimension represents the information processing aspect of the coordination process (Tushman and Nadler, 1978; Galbraith, 1974), the relationship dimension is similar to constructs of 'working together': shared goals implies aligning tasks and actions to accomplish tasks with interdependent others; shared knowledge requires understanding how interdependent tasks fit together; mutual respect allows one to value the others' contributions as well as consider the impact of knowledge and actions on the interdependent others (Gittell, 2000; Gittell, 2002; Gittell and Weiss, 2004; Gittell et al., 2008; Havens et al., 2010).

Quality of interpersonal relationships, often operationalized through trust, respect, psychological safety, and liking of teammates, tends to persist as mise–en–scène in team processes, evolve over time, and is often self-reinforcing (Cronin et al., 2011; Wageman,

1995; Edmondson, 2004). Relational coordination acknowledges an affectual aspect of interdependence and emphasizes the mechanisms that utilize the interpersonal relations and social networks (Gittell, 2012). According to relational coordination theory, the enabling condition that leads to coordination are positive relationship and effective information sharing.

2.4.2 Empirical Evidence of Relational Coordination

Relational coordination originated from studies of airline industry (Gittell, 2000; Gittell, 2001) and was found to be applicable in many other sectors, including the criminal justice system (Bond and Gittell, 2010), finance, software, electronic firms (Carmeli and Gittell, 2009) and in various healthcare delivery settings (Gittell et al., 2000; Gittell, 2002; Gittell et al., 2008; Havens et al., 2010; Weinberg et al., 2007; Cramm and Nieboer, 2012).

Here, I provide a review of the literature that specifically investigated relational coordination as a key construct. These studies were identified using PubMed, Google Scholars, and the Relational Coordination Research Collaborative's publication list using the keyword 'relational coordination'. This review excludes unpublished, in progress, or conceptual works that do not provide empirical evidence. Appendix A summarized detailed findings on relational coordination from these 26 publications identified through the search.

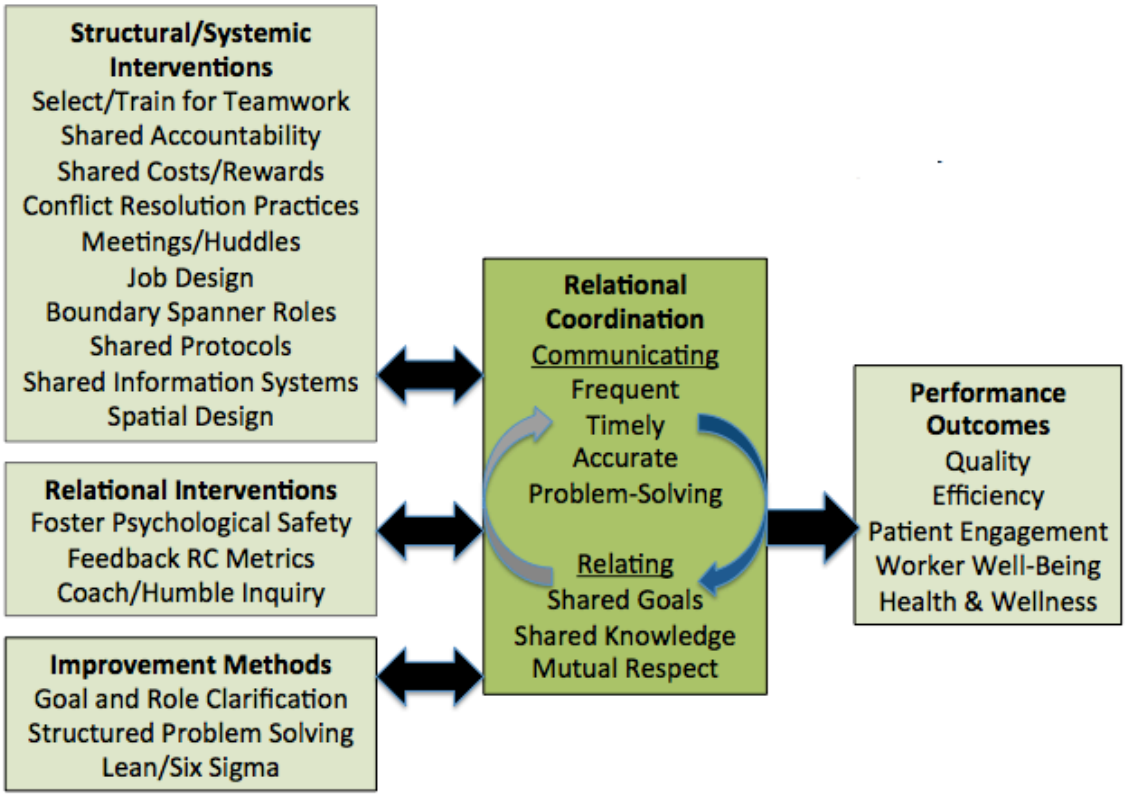

Figure 2. Relational Model of Organizational Change
(Adapted from Relational Coordination Research Collaborative website)

Empirical findings suggest that relational coordination predicts a variety of outcomes, from quality (Gittell et al., 2000; Gittell et al., 2008) and efficiency (Gittell et al.2000; Gittell et al., 2001) to worker well-being (Gittell et al., 2008; Warshawsky et al., 2012) and financial outcomes (Gittell et al., 2000). The concept of relational coordination has strong precursors in the organizational literature. The contingency factors I have described in the purview of coordination previously also apply to the relational coordination. Organizational characteristics, such as leadership, job design and role structures, rewards structures and performance measurement, and organizational governance can facilitate the development of relational coordination. The structural (Gittell et al.2010; Gittell, 2002), work process (Gittell et al., 2010; Gittell et al., 2008),

and relational (psychological safety) antecedents of relational coordination predict the development and strengthening of relational coordination. Figure 2 captures the relationship between predictors and outcomes of relational coordination.

2.4.3 Relational Coordination and Care Coordination

The relational coordination lens can provide a theoretical framework for team-based models of primary care. The framework of relational coordination and its utility in care coordination efforts have been documented in AHRQ's extensive review on care coordination (McDonald et al., 2007). Van Houdt and colleagues (2013), who extend the review of theoretical frameworks for the study of care coordination, also identified relational coordination as one of the most inclusive frameworks in evaluating elements of care coordination. Patient care is a coordination challenge and relational coordination is applicable to address the key concepts of care coordination: structure, task characteristics, knowledge, need for coordination, administrative operation processes, exchange of information and communication, goals, roles, quality of relationships, patient outcome, and organizational outcome (Van Houdt et al., 2013).

In research on health care, the concept of relational coordination has been gaining popularity in the last decade. It has been studied in inpatient (Gittell et al., 2000; Havens et al., 2010), surgical (Gittell, 2002; Weinberg et al., 2007), nursing homes (Gittell et al., 2008), and primary care settings (Cramm and Nieboer, 2012). The results from these studies have shown the importance of relational coordination and their associations with improved patient care outcomes.

Based on the argument that coordination is the management of interdependence, and is therefore fundamentally relational, we need to understand the importance of relationships in coordinating delivery of care. There is growing interest in the role relationship plays in care processes, and findings attesting to its benefits span across various settings, including intensive care (Shortell et al., 1994), surgical inpatient (Young et al., 1997), outpatient as well as caring for cancer patients (Bickell and Young, 2001). One mechanism used to explore the impact of relationship on care coordination is through a concept of boundary spanner.

Boundary spanners are individuals who work across functional boundaries to coordinate the tasks of others. Boundary spanners facilitate the communication and sharing of information and expertise by reaching across location, division, or function (Tushman and Scanlan, 1981). Boundary spanners develop partnerships and collaboration by building sustainable relationships through extensive social ties, and managing influence and negotiations through engaging in multi-directional knowledge transfers. Boundary spanners display high levels of contextual understanding and are aware of motives, roles, and responsibilities of other members in the organization (Williams, 2002; Long et al., 2013; Tushman and Scanlan, 1981).

Boundary spanners are not a foreign concept in care coordination. Many efforts to coordinate care have employed key workers assigned to perform coordination functions, including district liaison nurses (Armitage and Kavanagh, 1996), occupational therapists

(Clarke and Gladman, 1995), social workers (Nolan et al., 1987; Weinberger et al., 1993), health care assistants (Genischen et al., 2009; Keeney et al., 2005; McKenna et al., 2004), community health workers (Witmer et al., 1995; Navarro et al., 1998), panel managers (Bodenheimer et al., 2009), critical care assistants (McGuire et al., 2007), nurse practitioners (Mundinger et al., 2000), health trainers (Rudolf et al., 2006), community matrons (Murphy, 2004), patient navigators (Jandorf et al., 2005; Gardner et al., 2005), and case managers (Sutherland and Hayter, 2009; Eagan et al., 2002). Boundary spanners also are known to be associated with higher levels of relational coordination (operations agent in flight departure (Gittell, 2000) and case managers in surgical unit (Gittell et al., 2010). Moreover, in organizations with functional silos as in health care, designing boundary spanner roles to support the management of interdependent task promotes teamwork (Gittell, 2002).

2.5 Conceptual Design

This dissertation studies the effectiveness of a relationship-based approach to coordinating care using primary care teams. The care team includes a boundary spanner role, a care guide, who engenders relationship and embeds a tighter teamlet that supports care coordination in managing chronic illness. A care guide model is a team-based, goal-oriented, relationship-focused model of care with the active use of a lay boundary spanner. This novel approach to care resulted in a care teamlet within the patient's primary care practice to promote accountability, focus, responsiveness, and support that can be a clinically effective and economically sustainable chronic disease management model (Adair et al., 2012; Adair et al., 2013; Wholey et al., 2013).

The overarching aim of the care guide model of care was to use a team-based, patient centered approach to focus intensely on the basics of chronic disease management and empower patients' self-management. A coordinated care teamlet was identified and consisted of a patient, a care guide, and a provider. The primary goal of this teamlet was to address the inadequacies of ad hoc care teams through communication facilitated by the care guide and to ensure that all members of the care team focus on meeting best practice guidelines for the patient.

The organizational design of the intervention fostered the core elements of high performing health care teams: having shared goals, clear roles, mutual trust, effective communication, and measurable processes and outcomes (Mitchell et al., 2012). Care guides based in primary care clinics interacted with patients regularly, providing informational and navigational support and encouraging self-management. Upon enrollment, patients, primary care providers, and care guides signed a contract attesting to their collective commitment to achieve clearly articulated clinical benchmarks for optimal care, and this contract was embedded within each patient's electronic medical record. The electronic care contract and summary of targeted treatment goals were visible to care guides and providers in both inpatient and outpatient settings linked by the electronic medical record system, serving as a platform for inter-provider communication and care coordination. Care guides consulted with patients before and after clinic visits as needed, and maintained regular contact as needed with patients via telephone calls between clinic encounters in support of self-management efforts. The care guides helped

manage encounters and communications with patients and providers to keep the entire care team focus on meeting evidence-based best practice guidelines (Adair et al., 2013; Wholey et al., 2013). For instance, when a patient has an appointment with a physician, the care guide provides reminders and feedback in regards to patient's goal adherence, so that the care team can address the issue during the visit.

Care guides are individuals without formal clinical or medical training, who bring a set of interpersonal skills to the job that enables them to gain respect, earn trust, and build relationships across diverse participants in patient care including patients, their family members, and care providers including doctors, nurses, and clinic staffs (Adair et al., 2012; Adair et al., 2013; Wholey et al., 2013). Lay care guides are not members of the medical profession, and patients might perceive them as peers, and build relationships based on affect and trust. This affectual relationship built between care guides and patients may help alleviate the "white coat effect" that ultimately affects patient care (Wholey et al., 2013). For example, a diabetic patient might admit to the care guide, but not to her provider, that she wasn't taking insulin at all because she was afraid of needles. Care guides can support a better provision of care by alerting the provider about the issue, so that the provider can switch to oral diabetes medications, ultimately resulting in improved diabetes control. In another example, a care guide can inform a provider when a patient signals his readiness to try to quit smoking. The provider then offers nicotine substitutes and timely smoking cessation counseling. A care guide subsequently helps and encourages the patient's effort followed by regular telephone reinforcement. These examples describe a relational triad, a tighter teamlet formed around active use of lay

boundary spanners (Wholey et al., 2013). Care guides encourage patients to become active partners in their care. By providing patients with practical guidance, skills, and tools that will assist in circumventing or overcoming informational, financial, logistical, and motivational barriers to care (e.g., introducing patients to the wide variety of services available within the hospital system, including counseling, chemical dependency, diet, smoking cessation, and disease management education), care guides assist patients in increasing self-efficacy and confidence in their abilities to manage their chronic conditions (Adair et al., 2013; Wholey et al., 2013).

Care guides perform the role of boundary spanners between care teams and patients by serving as familiar, accessible points of contact in care delivery, providing oversight for care focused on evidence based practice, and monitoring, helping, and encouraging providers and patients to be a part of the collaborative care process. Care guides, by design, call the attention to the relational aspects of caring for chronically ill patients and systems thinking. Care guides help the members of the care team to be aware of the interdependent nature of the care and to recognize that effective care requires working with one another. Detailed accounts of how care guides support the development of relational coordination in care teams can be found in Wholey et al. (2013).

2.6 Specific Aims

This dissertation assesses the impact of intentional design and installation of boundary spanners to manage the interdependencies within care teams and its enabling effect on better management of chronic disease. Specifically, this work examines the relationship

between a care guide team care model and its performance on adherence to guideline recommended care, as moderated by relational coordination and mediated by continuity of care.

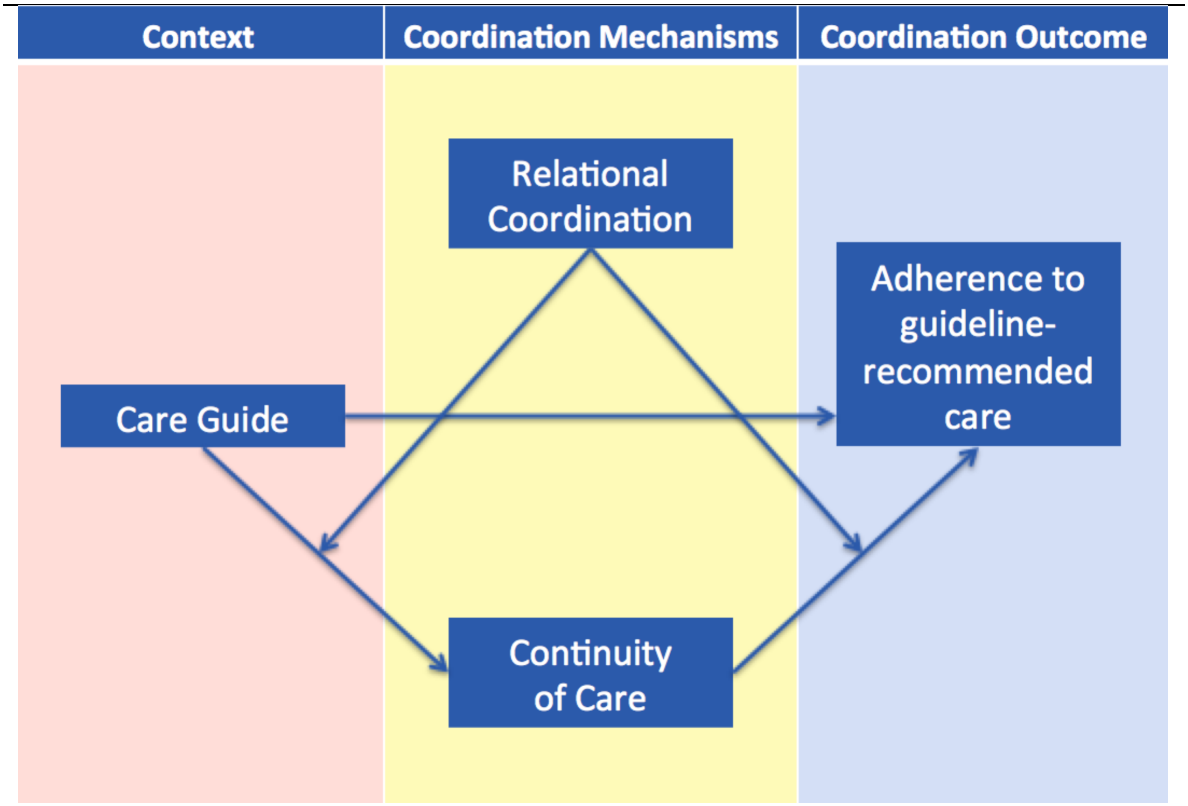

Figure 3. Conceptual Framework

Figure 3 provides a conceptual framework of proposed relationships for examining the mechanisms influencing the association between the care guide model of care and adherence to guideline recommended care. With respect to relationship-based approach to coordinating care using primary care teams, I hypothesize that coordination can be operationalized as coordination across work processes among team members (relational coordination) and strength of relationship that is continuous across the visits (continuity of care).

The specific aims of this dissertation research are to:

1. Examine whether relational coordination moderates the effectiveness of the care guide model on adherence to guideline-recommended care.

A care model focusing on relational processes will be most effective when relational coordination provides a strong contextual foundation for effective teamwork. Teamwork is expected to benefit from a positive relational climate, encouraging social interaction and communication to coordinate work (Schein, 1990; Schneider and Reichers, 1983). Consequently, it is hypothesized that patients working with a care guide team in clinics with higher levels of relational coordination would have better adherence to guideline-recommended care.

2. Determine whether continuity of care mediates the effectiveness of the care guide model on adherence to guideline-recommended care.

It is expected that the relationship and exchange of information developed around the tighter teamlet will provide an opportunity to form stronger bonds, less dispersed care, and better management of patient's health concerns. Strengthened relationship between patients and the care teams provide greater potential for improving coordination through continuity of care. Patients working with a care guide team are expected to have better continuity of care and, subsequently, better adherence to guideline-recommended care.

3. Examine whether the mediating effect of continuity of care is moderated by relational coordination in assessing the effectiveness of the care guide model on adherence to guideline-recommended care.

The combined effect of relational approaches on coordinating care is expected to increase the likelihood of delivering care that adheres to guideline recommendation. Patients working with a care guide teamlet in clinics with higher levels of relational coordination are hypothesized to have better continuity of care and, subsequently, better adherence to guideline-recommended care.

This dissertation work advances the understanding of a relational approach to coordinating care and conditions that support greater coordination with respect to team-based care.

CHAPTER 3. METHODOLOGY

This dissertation used data from a randomized control design to address the specific aims stated in the previous chapter. In this chapter, I describe the methodology employed in the dissertation, including the instruments used, data collection, and data analysis techniques.

3.1 Setting

3.1.1 Study Setting

The study setting was five primary care clinics in a single delivery system in Minnesota[1]. This large integrated system was a not-for-profit network of eleven hospitals and over eighty clinics, including various ambulatory clinics and specialty care centers. From 50 primary care clinics in the system, study sites were selected to maximize variation in size, provider specialty (family medicine or internal medicine) and geographic location (rural, urban, or suburban). Although the organizational design was similar across the clinics, the clinics varied in usual care, quality improvement strategies, and operational, administrative and governance processes. Each of these participating clinics had supportive and willing-to-participate physicians.

3.1.2 Study Sample

[1] Note: One clinic had two sites. Two sites operate in same name, are geographically very close to each other. Historical disagreement on practice style resulted the separation. Although the structure of these two clinics is similar, it is possible that administration, operation, and clinical culture be different between the two. Because of constraints in data collection, mainly survey administration for providers was at the clinic level and not at the site level, I treat the two sites as a single clinic rather than two clinics.

3.1.2.1 Patients

Study patients had one or more of three chronic conditions (hypertension, diabetes, and heart failure), were between ages of 18 to 79 years, and were not pregnant during and/or within the 12 months prior to the study. Eligible patients were identified from the electronic medical record. During the enrollment period, primary care physicians of these patients were notified on the date when the patients had an appointment at the clinic. Subsequently, additional screening may have occurred at the physician level, as physicians introduced and encouraged the patients to participate in the study. At initial contact between the care guide and the patient, the care guide explained the program, provided general information about the patient's chronic condition(s), discussed best practice guidelines and the benefits of attaining them, reviewed their current status on meeting these goals, and introduced patients to resources and support available within the clinic, health system, and community. Upon a patient's decision to participate in the study, patient's demographic information was collected, followed by random assignment to work with a care guide for one year (intervention group) or to receive usual care (control group) in 2:1 ratio. The full-scale intervention involved 2,125 patients. With twelve care guides housed in five clinics, the median caseload was 120 patients per care guide (range: 92~130 patients/CG, interquartile range: 118~121 patients/CG).

3.1.2.2 Providers

In addition to patient improvement in chronic disease management, I was also interested in the changes in work processes and relational processes following the introduction of the care guide in the study sites. Providers who take on the primary role in care delivery

at the five study clinics were asked to provide their assessment of the care guide and practice in general. Non-clinical staff members were excluded from the study. 132 providers, including 47 practitioners (physician, nurse practitioner, and physician's assistant), 76 clinical staff (RN, LPN, and CMA) and 9 care guides responded.

3.1.3. Data

3.1.3.1 Data Source

Electronic medical record (EMR) All of the data were collected and extracted by the health system. The patient's care guide documented primary endpoints. The administrative data and the encounter data were collected and extracted from the health system's electronic medical system by an in-house health informatician. Only the de-identified data were used in this dissertation.

Patient Survey During the enrollment, upon their decision to participate in the study and before the randomization, patients were asked to complete a survey to provide demographic information that was not available through the electronic medical record (EMR), including education level and primary language. Gender, age, race, and source of insurance were available through the EMR.

Provider Survey Providers and care guides from the five study sites were asked to provide their assessment of the care guide program and practice in general. Hard copies of deidentified surveys were collected at the clinic level, and Survey Monkey web tool was used to perform data entry.

3.1.3.2 Sample Size Considerations

This dissertation employs structural equation modeling (SEM) as the main analytic technique. While there is no consensus on reasonable sample size for SEM, it is recommended that estimating a complex model requires 100 cases or more (Kline, 2011). In addition, if the SEM model explores path analysis, each parameter should have at least 10~20 cases (Kline, 2011). With the full-scale study involving 2,125 patients, this research is not constrained to sample size requirements.

3.2 Instrumentation

3.2.1 Adherence to Guideline Recommended Care

The primary endpoint of this dissertation is meeting disease specific clinic benchmarks. These care goals were selected from the guidelines recommended by Joint National Committee on Prevention, Detection, Evaluation, and Treatment of high Blood Pressure, the American Heart Association, and the American Diabetes Association. Disease specific goals were:

- Hypertension goals
    - Systolic blood pressure < 140 mm/Hg
    - Diastolic blood pressure <90 mm/Hg
    - Not using tobacco
- Heart failure goals
    - Echocardiogram or other measure of LV function any time in the past
    - Prescription of beta blockers if left ventricular systolic dysfunction (LVEF) <40% *
    - Prescription of angiotensin converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) if left ventricular systolic dysfunction (LVEF) <40% *

    - Echocardiogram any time in the past
    - Not using tobacco
- Diabetes goals
    - Systolic blood pressure < 130 mm/Hg
    - Diastolic blood pressure <80 mm/Hg
    - Hemoglobin A1c < 8.0%
    - Measurement of urinary albumin within two years
    - Prescription of angiotensin converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) if urinary albumin > 30 mg/g creatinine *
    - Low density lipoprotein (LDL) < 100 mg/dL (2.6 mmol/L)
    - Pneumonia vaccination any time in the past
    - Retinal examination within two years
    - Not using tobacco

Conditional goals are marked with an asterisk*. These goals were applicable only if certain conditions were met. For example, if the diabetic patients were found to have albuminuria, they had additional benchmarks of being prescribed a drug affecting the renin-angiotensin system to preserve renal function. Each patient had 3 to 12 care goals depending on diagnoses. Adherence to guideline recommendations was measured before and one year after the introduction of the care guide in the team care model. Each individual goal was collected as binary variable (1: goal met, 0: goal not met), which provided a clear, quantitative measure of success or failure to adhere to guideline recommendation.

The outcome variable for each patient was the percentage of disease-specific care goals met one year after the enrollment. These were calculated from the attainment of individual goals the patient was recommended to meet, treating the applicable goals as having equal weight. The measure of the dependent variable involved 12 goals that target

better management of chronic illness. These goals can be further classified as 6 goals that target change in process of care (Echocardiogram, beta blocker, ACEI/ARB for heart failure patients, ACEI/ARB for diabetic patients, urinary albumin, and medication for microalbumin) and 6 goals that target change in clinical outcomes (blood pressure control, smoking, LDL control, HgA1c control, pneumonia vaccination, and eye exam). In addition to the analysis pertaining to overall adherence to guideline recommended care, I performed a series of sensitivity analyses addressing goals that focused on improving the process of care and goals that targeted better clinical outcomes.

3.2.2 Relational Coordination

The measure of relational coordination was comprised of five items derived from the Relational Coordination Survey. Items included problem-solving and timely communication, shared knowledge, mutual respect, and shared goals (Table 3). Each item had four possible response categories: 1 ("strongly disagree"); 2 ("disagree"); 3("agree"); and 4 ("strongly agree"). The measure of relational coordination was collected through the provider survey administered during the intervention. Practitioners (physician, nurse practitioner, and physician's assistant), clinical staff (registered nurse, licensed practical nurse, and certified medical assistant) and care guides were asked to answer a questionnaire approximately three months after the clinic started enrolling patients into the study. This lag was considered necessary to allow adequate time for the clinics to adopt new work practices involving integration of care guides and to evaluate the influence on the practice behavior accordingly.

RC Dimensions		*Survey questions*
Relationships	Mutual Respect	Thinking about the past THREE MONTHS, how much do you agree with the statement that each of the different type of clinic worker listed below with whom you regularly work ***RESPECT YOU***?
	Shared Knowledge	Thinking about the past THREE MONTHS, how much do you agree with the statement that each of the different type of clinic worker listed below with whom you regularly work ***KNOW ABOUT THE WORK YOU DO***?
	Shared Goals	Thinking about the past THREE MONTHS, how much do you agree with the statement that each of the different type of clinic worker listed below with whom you regularly work ***SHARE YOUR GOALS FOR PATIENT CARE***?
Communication	Problem Solving Communication	Thinking about the past THREE MONTHS, how much do you agree with the statement that each of the different type of clinic worker listed below with whom you regularly work HELP ***YOU SOLVE PATIENT CARE PROBLEMS***?
	Timely Communication	Thinking about the past THREE MONTHS, how much do you agree with the statement that each of the different type of clinic worker listed below with whom you regularly work ***RESPOND TO YOUR REQUESTS IN A TIMELY WAY***?

Table 3. Measuring Relational Coordination

3.2.2.1 Measurement Reliability and Validity

Confirmatory factor analysis (CFA) within SEM was performed to examine the measurement model of relational coordination and to verify its construct validity. SEM CFA models were examined and scale reliability of relational coordination was calculated. The scale reliability (ρ) is calculated by the squared sum of the unstandardized loadings $(\sum \lambda_i)^2$ divided by the squared sum of the sum of the unstandardized loadings $(\sum \lambda_i)^2$, the sum of the unstandardized error variances $(\sum \theta_{ii})$, and two times the sum of the unstandardized covariances of the errors $2(\sum \theta_{ij})$ (Acock, 2013).

$$\rho = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + (\sum \theta_{ii}) + 2(\sum \theta_{ij})}$$

Cronbach's alpha was used to assess internal consistency of the measure. Higher Cronbach's alpha measures indicate higher internal consistency of the construct. Nunnally (1978) recommends 0.7 or higher for attesting the reliability.

I report the number of distinct factors and fit structures to assess whether each survey question demonstrates adequate loadings to reflect the dimensions of relational coordination. Assessment of model fit in SEM evaluates how close the predicted data are to the actual data. Various formal statistical tests and fit indices have been developed. I report a selection of fit indices suggested by Kline (2011).

The chi square (χ^2) statistic compares the observed and predicted covariance matrices. It is ideal for the difference between the observed and the predicted covariance matrices to not be statistically significant, greater than 0.5. The comparative fit index (CFI) measures the relative improvement in the fit of the hypothesized model over the fit of the null measurement model. Higher values indicate better fit, and it is recommended for CFI to be greater than 0.95 to indicate good fit. Root mean square error of approximation (RMSEA) measures the model fit by estimating the difference between the observed and predicted covariance matrices. A RMSEA of zero indicates the best fit and higher values indicate a worse fit. There's little consensus on the specific value that determines acceptable fit but, in general, a RMSEA of less than 0.5 suggests reasonable error of approximation. Standardized root mean square residual (SRMR) is a measure of a mean

absolute correlation residual, the overall difference between the observed and predicted correlation. A SRMR of zero indicates a perfect fit and higher values indicate worse fit. Different levels of SRMR are considered, but in general, researchers agree a SRMR of less than 0.05~0.08 indicates reasonable fit (Kline, 2011; Hooper et al., 2008; Hu and Bentler, 1999).

The reason for checking these fit indices is not to find a model that fits the data, but to test a theory and examine if the model is consistent with the data. Accordingly, in addition to the assessment of the overall model fit, post hoc analyses were used to support model re-specification. Modification indices and expected parameter change values were examined. Model re-specification was considered only if both the assessment of post hoc analysis and the theory were supported.

Fit Index	Description	Acceptable Fit
Chi square (χ^2)	Compares the observed and predicted covariance matrices	$p \geq 0.05$ (Kline, 2011)
Comparative fit index (CFI)	Compares the model fit over the null measurement model	$CFI \geq 0.95$ (Hu and Bentler, 1999)
Root mean square error of approximation (RMSEA)	Measures the model fit in relation to the populations covariance matrix	$RMSEA \leq 0.05$ (Hooper et al., 2008)
Standardized root mean square residual (SRMR)	Compares the observed and predicted covariance based on covariance residuals	$SRMR \leq 0.08$ (Hooper et al., 2008)

Table 4. Measure of Fit Indices

3.2.2.2 Relational Coordination as a Group Variable

Once the factor structure has been validated and the measurement model is deemed acceptable, I calculate relational coordination constructs. For each dimensions of

relational coordination, I computed the average strength at the clinic level. I construct a bivariate grouping variable based on the levels of relational coordination: clinics exhibiting high relational coordination (=1) and low relational coordination (=0). Intraclass correlations (ICC) were considered to validate whether relational coordination can be assessed as a cluster-level construct.

3.2.3 Continuity of Care

The concept of continuity of care is in line with reinforcing bonds between patients and their physicians. Providers take on the primary role in the provision of care and often take accountability in clinical issues. In addition, face-to-face encounters with care guides predominantly occur around the patient's visits to the clinic.

The measure of continuity of care was calculated using a record of each ambulatory visit and the physician with whom the encounter took place for each patient. Ambulatory visits were defined as face-to-face encounters with providers (including family practice and internal medicine physicians, specialists, nurse practitioners, and physician assistants) that occurred within the health system during the one-year period from enrollment. Surgical office visits were eliminated, as these are not related to the provision of care for the study diagnosis.

Continuity of Care Index (COC)

This index weights both the frequency of visits to each provider and the dispersion of visits between providers.

$$COC = \frac{\sum_{i=1}^{M} n_j^2 - N}{N(N-1)}$$

where,

N = Total number of visits to all providers
n_j = Number of visits to *i*th provider (*i*= 1,2,….M)
M = Number of potentially available providers

COC index values range from 0 (where each visit made to a different provider) to 1 (all visits made to a single provider), with increasing scores indicating greater continuity of care (Reid et al., 2002; Saultz, 2003; Salisbury et al., 2009; Jee and Cabana, 2006).

Usual Provider Continuity (UPC)

This index describes the proportion of visits to the patient's most frequently seen provider out of all visits.

$$UPC = \frac{\max(n_1, n_2, \ldots n_M) - 1}{N - 1}$$

where,

N = Total number of visits to all providers
n_j = Number of visits to *i*th provider (*i*= 1,2,….M)
$\max(n_1, n_2, \ldots n_M) - 1$ = Number of visits to the provider with whom the patient had the greatest number of visits

The intervention is grounded on the concept of patient-centered medical home, with each patient having a regular physician, in this case a primary care physician (PCP). One can further modify the UPC index by defining a primary care physician or a regular provider based on the patient's visit pattern. The most frequently seen provider in primary care settings was identified as a patient's primary care provider. If a PCP is identifiable within the visits, the UPC index can be calculated as the proportion of visits to the patient's primary provider out of all visits.

$$UPC = \frac{n_i}{N}$$

where,

N = Total number of patient *i*'s ambulatory visits

n_i = Number of visits to a PCP by patient *i*

UPC index values range from 0 (no visit to the primary care physician) to 1 (all visits made to the primary care physician), with increasing scores indicating higher provider continuity (Reid et al., 2002; Saultz, 2003; Salisbury et al., 2009; Jee and Cabana, 2006).

Site-level Usual Provider Continuity (SITE)

In addition to constructing the UPC index using visits to primary care physicians as a denominator, I also performed sensitivity analyses using a SITE index. This modified UPC index at the site level, where the denominator was visits to the patient's primary care clinic. Many providers function as a group in order to cover for each other during days off or when schedules are too busy to accommodate last minute requests for a visit to a PCP. Accordingly, the SITE index will be sensitive to coordination within a particular clinic. In addition, the SITE index will conceptually better reflect 'medical homeness'.

$$SITE = \frac{n_i}{N}$$

where,

N = Total number of patient *i*'s ambulatory visits

n_i = Number of visits to a primary care home clinic by patient *i*

I present findings using these continuity of care indices because each measure of continuity of care has its strengths and weaknesses. The UPC index assesses continuity of care with a primary care physician. However, the UPC index does not account for the number of providers seen in a given period. The COC index, on the other hand, measures dispersion of care, but does not consider strength of the relationship with primary

provider. Because of these conceptual distinctions, this dissertation presents results based on the COC index, but also reports results of a sensitivity analysis performed using the UPC and SITE index.

3.3 Data Analysis Strategies

3.3.1 Analysis I

Analysis I examined whether relational coordination influenced the care guide effect on adherence to guideline recommended care. Moderation analysis is appropriate for testing buffering, enhancing, or situation specific conditions a predictor variable influences an outcome variable. Thus, the study grounds on the investigation of moderation effect, where the moderator is defined as relational coordination. A moderator is an independent variable that affects the strength and/or the direction of the causal effect of an independent variable and a dependent variable (Baron and Kenny, 1986). In this sense, the moderator influences the magnitude of the causal effect. In this study, relational coordination is a measure of the context under which the treatment is delivered. Depending on the level of relational coordination, the association between working with care guides and outcome can be strengthened, weakened, or change its direction (Ro, 2012; Muller et al., 2005).

Analysis I used multigroup SEM to examine the influence of relational coordination in assessing the benefits of working with care guides. Traditionally, an interaction term is used to assess moderation. SEM can advance the traditional approach by simultaneously fitting the model in two or more groups and testing for group differences. Although there

are no explicit interactions in the model, the moderation effects are implicit in modeling the multiple groups. Each parameter was allowed to vary between higher relational coordination (RC) and lower RC groups in the estimation process (unconstrained model). This unconstrained model was compared to the constrained model (the control variable and error variance constrained to be equal across groups) to determine better model fit. I used an asymptotically distribution free estimation method (ADF). ADF estimates a weighted least square estimator and is free of the normality assumption. It is less efficient than the default maximum likelihood estimator where that is appropriate, but more efficient than the quasi-maximum likelihood estimation. In a large sample, it is asymptotically equivalent to maximum likelihood estimator. The dependent variable is the percentage of goals met at one year after the intervention. To address the non-linearity and non-normality inherent in percentage measures, the ADF estimator is a better option compared to other estimation methods. The model fit was assessed using the Chi-square, RMSEA, CFI, and SRMR using the criteria for goodness of fit discussed earlier.

3.3.2 Analysis II

Analysis II investigated how working with care guides might influence the goal adherence. I hypothesized that continuity of care is an intermediary process that is a part of the care guide effect on goal attainment. I treat continuity of care as a mediator. A mediator is a variable that intervenes, or lies in between, the causal effect of an independent variable and a dependent variable. In this sense, mediation addresses how the treatment effect is produced. Mediation analysis attempts to identify the process that

leads from the independent variable to the outcome variable, implying that mediation affects the outcome or is a part of causal mechanisms (Baron and Kenny, 1986; Kenny, 2008).

Path analysis within structural equation modeling was used to test a mediation effect. Path analysis is related to the structural component in SEM. It is a model to incorporate, test, and assess causal assumptions. Analysis II used path analysis without measurement component, because all variables of interest were observed variables. Three types of variables are considered in path models: exogenous predictors, endogenous outcomes, and endogenous mediators. Exogenous variables are independent variables for which the path model does not specify any causal explanation. Endogenous outcome variables are dependent variables that are explained by the model with respect to all other variables. Endogenous mediators are variables that provide a causal mechanism linking the exogenous variables to the endogenous outcome variables. To strengthen the path model, I also included goal attainment at the baseline as a control variable, as preliminary studies has indicated that goal attainment at the baseline had a positive significant association with the goal attainment at the end of study (Adair et al., 2012; Adair et al., 2013). Because this is a simple covariate, the parameter estimates are excluded from the figures or tables. Because of the randomized control design, the strength of the analysis is in the randomization as well as having experimenter control over exposure to the independent variable, from care guide patients who are receiving a team-based care to the control group patients who are receiving usual care. Although causality should be used with caution (Bollen and Pearl, 2013; Shadish, Cook, and Campbell, 2001), having

randomization and control of the exposure to the independent variable strengthen the causal argument. Furthermore, I substantiated the causal argument by having the variables arranged in a time order: working with care guides as an independent variable; attainment of clinical benchmarks at one year after as a dependent variable; and continuity of care during the study year as a mediator.

Total, direct, and indirect effects were examined in the path analysis to validate the mediation hypothesis. Full mediation is justified when the significant direct effect of the independent variable becomes insignificant with the inclusion of a mediator in the causal pathway. Partial mediation is established when there is a decrease in the direct effect. I used the ADF method to estimate the models. The model fit was assessed using the Chi-square, RMSEA, CFI, and SRMR.

3.3.3 Analysis III

Analysis III aimed to simultaneously test analysis I and analysis II in the same model. I examined whether the mediating effect of continuity of care is strengthened, weakened, or has a different direction depending on the levels of relational coordination. To examine moderated mediation effect, I extended multiple group comparison SEM to the path. The moderated mediation model hypothesizes that the mediated relationship between the independent and dependent variable varies across the levels of the moderator (Muller et al., 2005). In this framework, the mediating process varies as a function of the moderator. Patients working with care guides are used as the predictor of continuity of care. Both

variables are hypothesized to lead to goal attainment at the end of the study, controlling for goal attainment at the baseline.

Multigroup SEM compares how pathways work for different groups. Multiple group analysis of path models focuses on the structural coefficients, the unstandardized paths in the model. It assesses which paths are significantly different between groups and which paths can be treated equal. It is a sophisticated methodological approach to substantively compare groups and an efficient way to test for interactions. With levels of relational coordination as a grouping variable, I applied a multigroup path model to examine whether working with care guides will be more or less important for one group than they are for the other group.

For the unconstrained model, all the parameters being estimated in the path model are allowed to be different for the two groups (levels of relational coordination). Both groups are estimated simultaneously with no equality constraints across the groups, allowing path coefficients and the error variances to differ across groups. This unconstrained model was compared to the constrained model (the control variable and error variance constrained to be equal across groups) to determine better model fit.

Total, direct, and indirect effects were examined. Moderated mediation is justified when a moderator variable interacts with a mediator variable such that the value of the indirect effect changes depending on the value of the moderator variable. This conditional indirect effect was examined in the path analysis to validate the moderated mediation

hypothesis. I used an asymptotically distribution free estimation method. The model fit was assessed using the Chi-square, RMSEA, CFI, and SRMR.

For all statistical analyses, I used STATA software, version 13 (StataCorps, College Staion, TX). P values ≤ 0.05 were considered statistically significant.

CHAPTER FOUR: ANALYSIS

4.1. Descriptive Statistics

4.1.1. Sample Characteristics

During a rolling enrollment of six months, 2,455 patients were referred by providers; 2,135 (87%) patients elected to participate. Nine patients withdrew consent and one became pregnant, leaving 2,125 patients actively enrolled in the study. Table 5 summarizes the characteristics of the 2,125 patients enrolled in the study. Because I used a subsample of these patients for Analysis II and Analysis III excluding patients with less than three ambulatory visits during the study period, characteristics of the 1,759 patients in the subsample are included in Table 5 as well. The patients were predominantly white, used English at home, and were well educated, with nearly 60 % having an education beyond high school. I performed independent group t-tests to verify that the randomization worked. No differences in demographic characteristics were found.

	All patients (N=2125)		**Sub Sample (N=1759)**	
	Care Guide (N=1423)	*Usual Care (N=702)*	*Care Guide (N=1187)*	*Usual Care (N=572)*
Diabetes, %	65.35%	62.11%	68.41%	65.73%
Hypertension %	82.01%	79.77%	81.13%	79.20%
Heart failure, %	6.68%	4.84%	7.08%	5.42%
> 1 diagnosis, %	50.39%	45.01%	53.24%	48.25%
Female, %	49.75%	52.56%	51.14%	54.90%
White, %	90.44%	91.03%	90.23%	90.56%
Speak English at home, %	98.24%	98.15%	98.15%	98.60%
Less than High School, %	38.63%	38.80%	40.51%	40.63%
Mean age, y	61.06	60.86	61.46	61.31
Goals Met at the baseline, %	74.32%	75.67%	74.55%	76.32%

Table 5. Patient Characteristics

4.1.2 Measure Validation

4.1.2.1. Relational Coordination

The measure of relational coordination consisted of 5 items derived from the Relational Coordination Survey. Modification indices suggested error variance between respect and problem solving covary. Confirmatory factor analysis for the final model was examined. Cronbach's alpha was 0.87 and scale reliability was 0.88, suggesting that the construct has a high level of reliability. Model fit indices were examined and suggested that I have a good measurement model ($\chi^2(4) = 2.043$, $p = 0.728$, RMSEA = 0.000, CFI = 1.000).

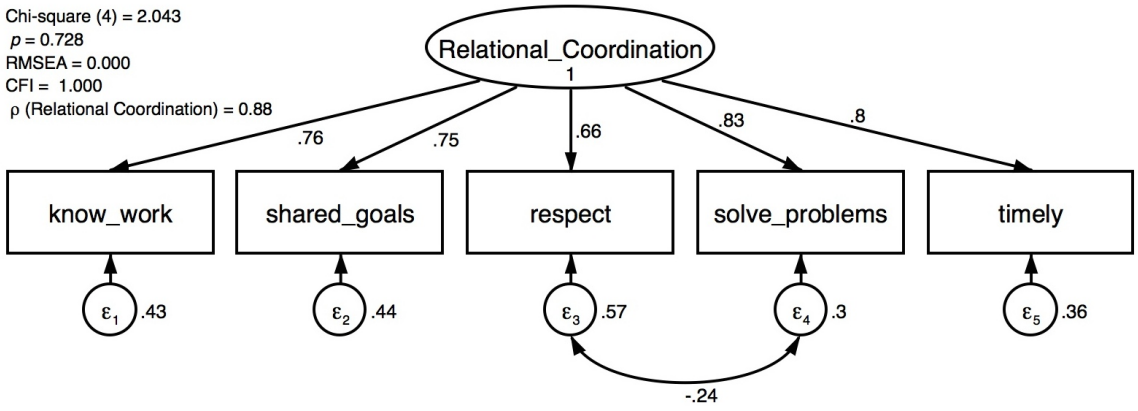

Figure 4. Confirmatory Factor Analysis for Relational Coordination, Final Model

Upon determining that the relational coordination measured through the provider survey constitutes a reliable index, I examined the patterns of relational coordination by each study site (Table 6). The pattern of relational coordination scores suggested that clinics could be categorized into two groups: clinics exhibiting high levels of relational coordination (Clinic A, B, and C) and lower levels of relational coordination (Clinic D and E). To verify aggregation of relational coordination as a group-level construct, I assessed intraclass correlation (ICC). The estimated intraclass correlation measures the

similarity or reliability of mean ratings from corresponding groups. The estimated intraclass correlation between individuals was 0.431 (F (67.0, 272.0) = 4.79, $p < 0.000$) for a low RC group and 0.600 (F (60.0, 244.0) = 8.50, $p < 0.000$) for a high RC group. The intraclass correlation within group average was 0.791 for a low RC Group (N = 68, F (67.0, 272.0) = 4.79, $p < 0.000$) and 0.882 for a high RC group (N = 61, F (60.0, 244.0) = 8.50, $p < 0.000$). I determined that there was statistical evidence to analyze relational coordination as a group-level variable.

Clinic	N	Relational Coordination	RC By Dimension	
			Communication	*Relationship*
A	25	3.377	3.373	3.380
B	14	3.410	3.464	3.373
C	23	3.502	3.442	3.541
D	15	3.190	3.179	3.206
E	55	3.239	3.252	3.229
Total	132	3.323	3.323	3.325

Table 6. Relational Coordination by Study Sites

Because I did not want significant differences in baseline measures across the study group or the RC group, I assessed baseline differences using analysis of variance (ANOVA) with study groups and levels of RC. No significant differences in baseline goal attainment were found between study groups, between RC levels, or when study groups and RC levels were considered jointly.

Levels of RC	Study Group		Total
	Usual Care	*Care Guide Patients*	
Low	75.98%	73.75%	74.49%
High	75.37%	74.87%	75.04%
Total	75.67%	74.32%	74.76%

Table 7. Baseline goal attainment (%),
by Study Group and Levels of Relational Coordination

4.1.2.2 Continuity of Care

When assessing the continuity of care, I only used data from the patients who had three or more ambulatory visits over the one year study period, resulting N of 1,759. I excluded 366 patients with less than three ambulatory visits, because both COC and UPC measures are uninformative and unstable for those who had less than three visits. For example, if a patient had one visit over one year, the COC index will equal 0. If a patient had two visits in one year study period, the COC index will be 0 if a patient saw two different providers once, whereas the COC index will be 1 if the two visits were made to a single provider. Table 8 tabulates the measures of continuity of care by study groups and RC levels.

	Low RC			**High RC**		
	Care Guide (N=572)	*Usual Care (N=280)*	*Total (N=852)*	*Care Guide (N=615)*	*Usual Care (N=292)*	*Total (N=907)*
COC	0.617	0.642	0.625	0.616	0.605	0.612
UPC	0.752	0.767	0.757	0.744	0.747	0.745
SITE	0.836	0.860	0.844	0.882	0.889	0.884

Table 8. Continuity of Care by Study Group and Levels of Relational Coordination

4.2 Analysis

4.2.1 Analysis I

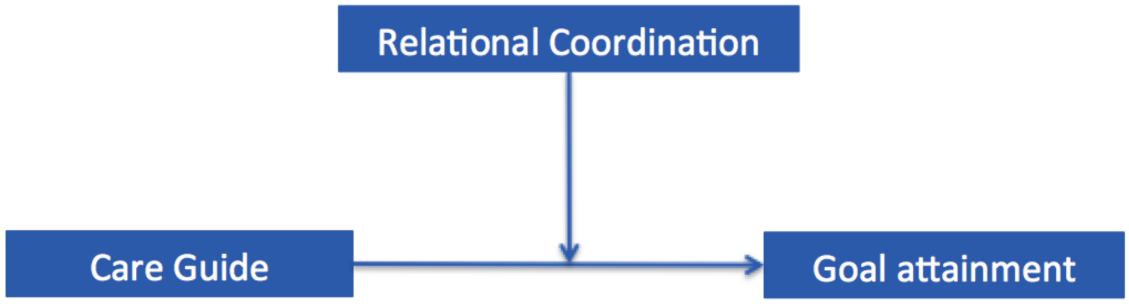

Figure 5. Conceptual Model for Analysis I

4.2.1.1 Full Sample

Analysis I used multigroup SEM to examine whether relational coordination influenced the care guide effect on goal attainment at one year. Each parameter was allowed to vary between higher RC and lower RC groups. I compared the unconstrained model with no equality constraints to the constrained model, where I constrained the control variable (goal attainment at the baseline) and the residual variance to be equal across groups. Assessing the model fit indices, the constrained model did not perform any worse than the unconstrained model. Therefore, I based my analysis on the constrained model ($\chi^2(2) = 0.459$, $p = 0.795$, RMSEA = 0.000, CFI = 1.000, SRMR = 0.018). The final model had slightly more explanatory power to predict goals met at the end of the study for the high RC group ($R^2 = 0.232$) compared with the low RC group ($R^2 = 0.227$).

Unconstrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.031*	0.071*	0.035**	0.083**
R2	0.222		0.235	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.030*	0.072*	0.036**	0.084**
R2	0.227		0.232	
χ^2	$\chi^2(2) = 0.459$, $p = 0.795$			
CFI	1.000			
RMSEA	0.000			
SRMR	0.018			

Table 9. Summary Table for Analysis I, Overall Goals

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Working with care guides had a positive, statistically significant effect on predicting percent of goals met at the end of the study, controlling for percent of goals met at the baseline. This effect was significant for both patients seen at lower relational coordination sites (B = 0.0303, z = 2.53, p = 0.011) as well as patients seen at higher relational coordination sites (B = 0.0357, z = 3.03, p = 0.002). There was no significant difference between the two groups ($\chi^2(1) = 0.073$, $p = 0.787$).

Process Goals To better understand where interventions had an effect and when relational coordination mattered, I performed a series of subgroup analyses. The measure of the dependent variable involved 12 goals that target better management of chronic illness. These goals can be further classified as 6 goals that target change in process of care and 6 goals that target change in clinical outcomes. Sensitivity analysis for process goals used multigroup SEM to examine whether relational coordination influenced the care guide effect on process goal attainment at one year. I compared the unconstrained model with no equality constraints to the constrained model, where I constrained the control variable (process goal attainment at the baseline) and the residual variance were equal across groups. Assessing the model fit indices, the constrained model did not perform any worse than the unconstrained model. Therefore, I based my analysis on the constrained model ($\chi^2(2) = 5.024$, $p = 0.081$, RMSEA = 0.038, CFI = 0.999, SRMR = 0.007). The final model had slightly more explanatory power to predict goals met at the end of the study for high RC group (R^2= 0.577) compared with the low RC group (R^2 = 0.568).

The effect of working with care guides on meeting process goals was statistically insignificant for patients who received care in low relational coordination sites (B = 0.0326, z = 1.38, p = 0.168). However, this same coefficient was positive and statistically significant for patients who worked with care guides in higher relational coordination sites (B = 0.1005, z = 6.15, p < 0.000). The difference between the two groups was statistically significant ($\chi^2(1)$ = 5.529, p = 0.0187). It appears that working with care guides was a significant predictor of meeting process goals in chronic disease management, but only if the care was received in relationally coordinated clinics.

Unconstrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.037	0.037	0.109***	0.107***
R2	0.538		0.591	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR				
Constrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.033	0.032	0.100***	0.100***
R2	0.568		0.577	
χ^2	$\chi^2(2) = 5.024$, $p = 0.081$			
CFI	0.999			
RMSEA	0.038			
SRMR	0.007			

Table 10. Summary Table for Analysis I, Process Goals

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Outcome Goals Sensitivity analysis for outcome goals used multigroup SEM to examine whether relational coordination influenced the care guide effect on outcome goal attainment at one year. I compared the unconstrained model with no equality constraints

to the constrained model, where I constrained the control variable (outcome goal attainment at the baseline) and the residual variance to be equal across groups. Assessing the model fit indices, the constrained model did not perform any worse than the unconstrained model. Therefore, I based my analysis on the constrained model ($\chi^2(2) = 0.592$, $p = 0.744$, RMSEA = 0.000, CFI = 1.000, SRMR = 0.020). The final model had similar explanatory power to predict goals met at the end of the study for low RC group ($R^2 = 0.231$) and the high RC group ($R^2 = 0.230$).

Unconstrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.028*	0.059*	0.028*	0.063*
R2	0.233		0.227	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR				
Constrained Solution				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.027*	0.059*	0.029*	0.064*
R2	0.231		0.230	
χ^2	$\chi^2(2) = 0.592$, $p = 0.744$			
CFI	1.000			
RMSEA	0.000			
SRMR	0.020			

Table 11. Summary Table for Analysis I, Outcome goals

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Working with care guides had a positive, statistically significant effect on percent of outcome goals met at the end of the study, controlling for percent of outcome goals met at the baseline. This effect was significant for both patients seen at lower relational coordination sites ($B = 0.0271$, $z = 2.12$, $p = 0.034$) as well as patients seen at higher

relational coordination sites (B = 0.291, z = 2.31, p = 0.021). There was no significant difference between the two groups ($\chi^2(1) = 0.012$, $p = 0.9128$).

4.2.1.2. Sub Sample: Frequent users (> 3 visits during the study year)

Results from the Analysis I supported that the benefit of working with care guides was positive and statistically significant for attaining disease specific goals. Moreover, similar results were found when I performed a sensitivity analysis on goals that target to improve clinical outcomes. In addition, for the goals focused on improving process of care provisions, I found that relational coordination enhanced the care guide effect: working with care guides had a larger, positive, and statistically significant effect on meeting process goals in chronic disease management, but only if the care was received in relationally coordinated clinics.

In subsequent analyses, analysis II and analysis III, I used a sub-sample of 1,759 patients, excluding patients who had less than three ambulatory visits during the study period to construct a reliable measure of continuity of care. In order to provide a comparable effect of working with care guides, I performed additional sensitivity analyses on the sub group of patients, using the same technique employed in the analysis I.

Overall - Sub Sample Because the constrained model showed acceptable model fit, I based my analysis on the constrained model ($\chi^2(2) = 1.314$, $p = 0.518$, RMSEA = 0.000, CFI = 1.000, SRMR = 0.030). Working with care guides had a positive, statistically significant effect on predicting percent of goals met at the end of the study for the low

RC group (B = 0.0280, z = 2.14, p = 0.032); however, the effect was smaller and not significant for the high RC group (B = 0.0142, z = 1.20, p = 0.231). It appears that, for the frequent users, working with care guides was a significant predictor of meeting goals in chronic disease management, but only if the care was received in low relational coordination sites.

Process Goals - Sub Sample Because the fully constrained model did not provide a good model fit ($\chi^2(2)$ = 11.396, p = 0.003, RMSEA = 0.073, CFI = 0.994, SRMR = 0.015), following the results from post hoc analysis on group invariance, I let the residual variance differ across the groups. The final constrained model only had an equality constraint on the control variables ($\chi^2(1)$ = 0.309, p = 0.578, RMSEA = 0.000, CFI = 1.000, SRMR = 0.004). The effect of working with care guides on meeting process goals was insignificant for patients who received care in low relational coordination sites (B = 0.0456, z = 1.88, p = 0.060). However, this same coefficient was positive and statistically significant for patients who received care in higher relational coordination sites (B = 0.1223, z = 6.07, $p < 0.000$). The difference between the two groups was statistically significant ($\chi^2(1)$ = 6.601, p = 0.014). It appears that working with care guides was a significant predictor of meeting process goals for frequent users, but only if the care was received in relationally coordinated clinics.

Outcome Goals - Sub Sample Because the constrained model showed acceptable model fit, I based my analysis on the constrained model ($\chi^2(2)$ = 0.865, p = 0.649, RMSEA = 0.000, CFI = 1.000, SRMR = 0.022). Working with care guides had no statistically

significant effect on predicting percent of outcome goals met at the end of the study, controlling for percent of outcome goals met at the baseline. This effect was insignificant for both patients seen at lower relational coordination sites (B = 0.0230, z = 1.63, p = 0.102) and patients seen at higher relational coordination sites (B = 0.0063, z = 0.49, p = 0.627). There was no significant difference between the two groups ($\chi^2(1) = 0.759$, p = 0.3837).

Constrained Solution: Overall goals, subsample				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.028*	0.072*	0.014	0.036
R2	0.172		0.177	
χ^2	$\chi^2(2) = 1.314$, p = 0.518			
CFI	1.000			
RMSEA	0.000			
SRMR	0.030			
Constrained Solution: Process goals, subsample				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.046	0.046	0.123***	0.124***
R2	0.517		0.553	
χ^2	$\chi^2(1) = 0.309$, p = 0.578			
CFI	1.000			
RMSEA	0.000			
SRMR	0.004			
Constrained Solution: Outcome goals, subsample				
	Low RC (N=1052)		*High RC (N=1073)*	
	B	β	B	β
CG effect	0.023	0.054	0.006	0.015
R2	0.176		0.175	
χ^2	$\chi^2(2) = 0.865$, p = 0.649			
CFI	1.000			
RMSEA	0.000			
SRMR	0.022			

Table 12. Summary Table for Analysis I, Sub Sample (N=1759)

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2.2 Analysis II

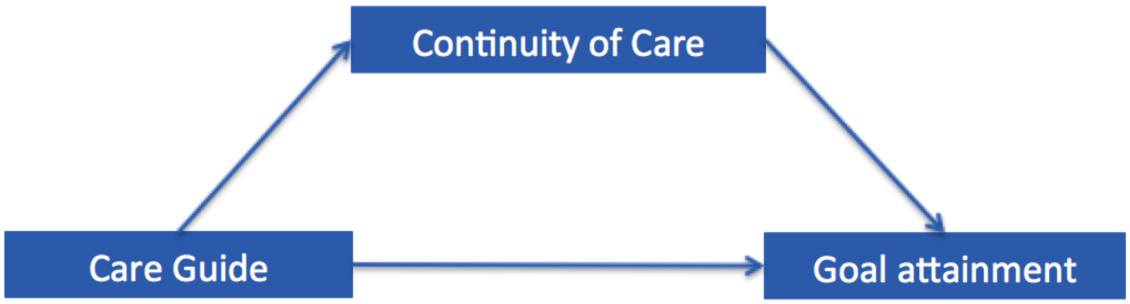

Figure 6. Conceptual model for Analysis II

4.2.2.1 Using Continuity of Care Index (COC) as a Measure of Continuity of Care

Path analysis was performed to examine if continuity of care mediates the care guide effect on meeting chronic disease management goals. I hypothesized that care guides affect continuity of care, measured by the continuity of care index (COC), which leads to the attainment of clinical benchmarks, controlling for the baseline goal attainment. The path model was just-identified with zero degrees of freedom. Any model with zero degrees of freedom will have $\chi^2(0) = 0.000$, RMSEA = 0.000, and CFI = 1.000. This does not mean the model is necessarily good or bad, but is just-identified and one cannot assess the model fit. To assess the presence of a mediation effect, I report standardized path coefficients with unstandardized *z*-test probability. The significance levels are based on the z tests and probability for the unstandardized solution because the specific *z*-tests for the indirect and direct effects are not available in the standardized solution. Although coefficients and corresponding tests may differ between the unstandardized and

standardized estimates, it generally does not result in differences in overall significance level.

The total effect for working with care guides was 0.02130. This is the effect one would find if there were no mediators in the model. The effect was significant with a z of 2.41 and p value at 0.016. The direct effect for CG was 0.02136, which was significant (z = 2.41, p = 0.016) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0.00006, and statistically not significant (z = -0.36, p = 0.718). The proportion of total effect mediated was very small. Working with care guides was a significant predictor of goal attainment at the end of the study, and this direct effect was significant after controlling for continuity of care and goal attainment at the baseline. However, there was no statistical evidence to confirm the mediating role of continuity of care.

Process Goals I performed a sensitivity analysis by specifying the dependent variable as meeting process goals. The total effect for working with care guides was 0.0845. The effect was significant with a z of 5.27 and p value less than 0.000. The direct effect for CG was 0.0848, which was significant (z = 5.29, $p < 0.001$) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0.0069, and statistically not significant (z = -0.43, p = 0.671). The proportion of total effect mediated was very small. Working with care guides was a significant predictor of process goal attainment at the end of the study, and this direct effect was significant when I controlled for continuity of care and process goal attainment at the baseline. Although there is no

statistical evidence to confirm the mediating role of continuity of care, I found that there was a significant direct effect of continuity of care on the end of the study process goal attainment (0.0498, $z = 2.07$, $p = 0.038$). When controlling for care guide effect, higher continuity of care was associated with meeting process care goals at the end of the study.

Outcome Goals In contrast, the significance of working with care guides disappeared when one considers goals focusing on clinical outcomes. The total effect for working with care guides was 0.01449. The effect was not significant with a z of 1.51 and p value at 0.130. The direct effect for CG was 0.01449, which was not significant as well ($z = 1.52$, $p = 0.130$). The indirect effect of CG that passes through continuity of care was very close to 0, and statistically not significant ($z = -0.01$, $p = 0.995$). Working with care guides was not a significant predictor of outcome goal attainment at the end of the study, when I controlled for continuity of care and goal attainment at the baseline. Moreover, there was no statistical evidence to confirm the mediating role of continuity of care.

4.2.2.2 Sensitivity Analysis

I performed sensitivity analyses to see whether the results of analysis II would differ if continuity of care were measured using usual provider continuity index (UPC) and site continuity index (SITE) as measures of continuity of care.

UPC Overall The total effect for working with care guides was 0.0213. The effect was significant with a z of 2.41 and p value at 0.016. The direct effect for CG was 0.0214, which was significant ($z = 2.42$, $p = 0.016$) and very similar to the total effect. The

indirect effect of CG that passes through continuity of care was -0. 00012 and was statistically not significant (z = -0.53, p = 0.594). The proportion of total effect mediated was very small.

UPC Process Goals The total effect for working with care guides was 0. 0845. The effect was significant with a z of 5.27 and p value at 0.000. The direct effect for CG was 0. 0849, which was significant (z = 1.42, p = 0.000) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0.00043 and was statistically not significant (z = -0.69, p = 0.490). The proportion of total effect mediated was very small.

UPC Outcome Goals The total effect for working with care guides was 0.0145. The effect was not significant with a z of 1.51 and p value at 0.130. The direct effect for CG was 0.0145, which was also not significant (z = 1.52, p = 0.129) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0. 00002 and was statistically not significant (z = -0.13, p = 0.900).

SITE Overall The total effect for working with care guides was 0.0213. The effect was significant with a z of 2.41 and p value at 0.016. The direct effect for CG was 0.0214, which was significant (z = 2.42, p = 0.016) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0.0001, and was statistically not significant (z = -0.32, p = 0.753). The proportion of total effect mediated was very small.

SITE Process Goals The total effect for working with care guides was 0.0845. The effect was significant with a *z* of 5.27 and *p* value at 0.000. The direct effect for CG was 0.0854, which was significant (z = 5.33, p = 0.000) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0.0001, and statistically not significant (z = -1.10, p = 0.269). The proportion of total effect mediated is very small.

SITE Outcome Goals The total effect for working with care guides was 0.0145. The effect was not significant with a *z* of 1.51 and *p* value at 0.130. The direct effect for CG was 0.0143, which was not significant as well (z = 1.49, p = 0.135) and very similar to the total effect. The indirect effect of CG that passes through continuity of care was -0. 0002, and was not statistically significant (z = -0.52, p = 0.606).

4.2.3 Analysis III

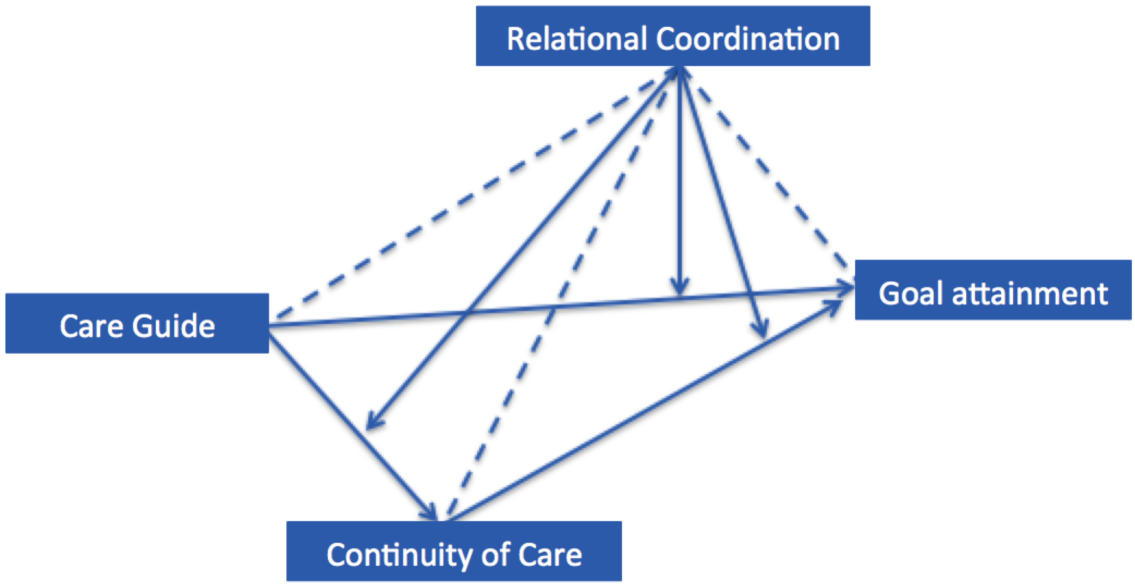

Figure 7. Conceptual Model for Analysis III

Analysis III simultaneously tested analysis I and analysis II in the same model. A multigroup SEM technique was extended to path models to test for moderated mediation effects. Each path coefficient was allowed to vary between higher RC and lower RC groups. I compared the unconstrained model with no equality constraints to the constrained model, where I constrained the control variable (goal attainment at the baseline) and the residual variance to be equal across groups. Assessing the model fit indices, the constrained model did not perform any worse than the unconstrained model. Therefore, I based my analysis on the constrained model ($\chi^2(2) = 4.014$, $p = 0.795$, RMSEA = 0.002, CFI = 1.000, SRMR = 0.025). The final model had slightly more explanatory power to predict goals met at the end of the study for high RC group (R^2= 0.177) compared with the low RC group ($R^2 = 0.174$).

The total effect for working with care guides was 0.027 for patients seen at lower relational coordination sites. This is the effect one would find if there were no mediators in the model. It was significant with $z = 2.09$, $p = 0.036$. The direct CG effect for the low RC group was 0.028 and significant ($z = 2.11$, $p = 0.035$). The indirect care guide effect mediated by continuity of care was -0.0002, and was statistically not significant (z=-0.048, $p = 0.632$). The total effect for working with care guides was 0.0139 and not significant (z=1.17, $p = 0.241$) for patients seen at higher relational coordination sites. The direct CG effect for the high RC group was 0.0139 and not significant (z=1.17, $p = 0.242$). The indirect care guide effect mediated by continuity of care was -0.00002, and statistically not significant (z=0.10, $p = 0.917$).

Working with care guides had a positive, statistically significant effect on predicting percent of goals met at the end of the study, controlling for baseline goals met. This effect was significant only for patients seen at lower relational coordination sites. There was no statistical evidence to support the mediating role of continuity of care in predicting goal attainment at the end of the study for both levels of relational coordination.

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.015	0.024	0.003	0.006
CG → Y1	0.029*	0.072*	0.014	0.037
COC				
CG → COC	-0.026	-0.041	0.011	0.017
R2 Y1	0.154		0.188	
R2 COC	0.003		0.0004	
overall χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.010	0.017	0.002	0.003
CG → Y1	0.028*	0.071*	0.014	0.035
COC				
CG → COC	-0.023	-0.035	0.011	0.016
R2 Y1	0.172		0.177	
R2 COC	0.002		0.0008	
overall χ^2	$\chi^2(4) = 4.014$, $p = 0.404$			
CFI	1.000			
RMSEA	0.002			
SRMR	0.025			

Table 13. Summary table for Analysis III, Overall goals, COC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Process Goals I performed a sensitivity analysis by specifying the dependent variable as meeting process goals. Each path coefficient was allowed to vary between higher RC and lower RC groups. I compared the unconstrained model with no equality constraints to the constrained model, where I constrained the control variable (process goal attainment at the baseline) and the residual variance to be equal across groups. The fully constrained model did not have acceptable model fit ($\chi 2(4) = 16.958$, $p = 0.002$, RMSEA = 0.061, CFI = 0.992, SRMR = 0.021). Results from the post hoc analysis testing for group invariance of parameters suggested that low RC patients and high RC patients might differ on the residual variances of process goal attainment at the end of study. The final model constrained the control variable and residual variance of continuity of care to be equal in both groups, but allowed the residual variances of end of the study process goal attainment to vary. The estimated model had acceptable model fit ($\chi^2(3) = 7.751$, $p = 0.051$, RMSEA = 0.042, CFI = 0.997, SRMR = 0.019). The final model had more explanatory power to predict goals met at the end of the study for high RC group ($R^2 = 0.551$) compared with the low RC group ($R^2 = 0.516$).

The total effect for working with care guides was 0.047 for patients seen at lower relational coordination sites. This is the effect one would find if there were no mediator in the model. It was significant with $z = 1.92$, $p = 0.054$. The direct CG effect for the low RC group was 0.049 and significant ($z = 2.03$, $p = 0.043$). The indirect care guide effect mediated by continuity of care was -0.0026, and was not statistically significant ($z = -1.02$, $p = 0.310$). The total effect for working with care guides was 0.124 and was significant ($z = 6.12$, $p < 0.001$) for patients seen at higher relational coordination sites.

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.114**	0.074**	-0.008	-0.005
CG → Y1	0.049*	0.049*	0.120***	0.120***
COC				
CG → COC	-0.025	-0.038	0.012	0.018
R^2 Y1	0.509		0.564	
R^2 COC	0.002		0.006	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			

Constrained Solution: fully constrained				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.134**	0.088**	-0.003	-0.002
CG → Y1	0.044	0.045	0.111***	0.110***
COC				
CG → COC	-0.024	-0.036	0.011	0.016
R^2 Y1	0.545		0.551	
R^2 COC	0.001		0.000	
χ^2	$\chi^2(4) = 16.958$, $p = 0.002$			
CFI	0.992			
RMSEA	0.061			
SRMR	0.021			

Constrained Solution: final model				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.111**	0.072**	-0.008	-0.005
CG → Y1	0.049*	0.049*	0.124***	0.125***
COC				
CG → COC	-0.023	-0.035	0.011	0.016
R^2 Y1	0.517		0.551	
R^2 COC	0.002		0.001	
χ^2	$\chi^2(3) = 7.751$, $p = 0.051$			
CFI	0.997			
RMSEA	0.042			
SRMR	0.019			

Table 14. Summary table for Analysis III, Process goals, COC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The direct CG effect for the high RC group was 0.124 and was significant ($z = 6.12$, $p < 0.001$). The indirect care guide effect mediated by continuity of care was -0.00008, and was statistically not significant ($z = -0.21$, $p = 0.834$).

Working with care guides had a positive, statistically significant effect on the percent of process goals met at the end of the study, controlling for baseline goals met. This effect was significant across the both levels of relational coordination. Although both groups exhibited positive association between working with care guides and attaining goals that target better process of care, there was a statistically significant difference between the higher relationally coordinated clinics from the lower relationally coordinated clinics on the direct CG effect ($\chi^2(1) = 5.6442$, $p = 0.018$). There was no statistical evidence to support a mediating role of continuity of care in predicting process goal attainment at the end of the study for both groups. However, there was a direct effect of continuity of care in predicting process goal attainment for patients seen at lower relational coordination clinics. This difference was statistically significant ($\chi^2(1) = 6.065$, $p = 0.014$).

Outcome Goals Multigroup SEM technique was extended to path models to test for moderated mediation effects on outcome goals. Each path coefficient was allowed to vary between higher RC and lower RC groups. I compared the unconstrained model with no equality constraints to the constrained model, where I constrained the control variable (goal attainment at the baseline) and the residual variance to be equal across groups. Assessing the model fit indices, the constrained model did not perform any worse than the unconstrained model. Therefore, the analysis was based on the fully constrained

model ($\chi^2(4) = 3.891$, $p = 0.421$, RMSEA = 0.000, CFI = 1.000, SRMR = 0.020). The final model had similar explanatory power to predict goals met at the end of the study for the low RC group ($R^2 = 0.176$) and the high RC group ($R^2 = 0.175$).

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	0.003	0.005	-0.002	-0.003
CG → Y1	0.023	0.054	0.006	0.014
COC				
CG → COC	-0.026	-0.041	0.011	0.017
R2 Y1	0.164		0.182	
R2 COC	0.002		0.0003	
overall χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
COC → Y1	-0.001	-0.001	-0.003	-0.005
CG → Y1	0.022	0.053	0.006	0.014
COC				
CG → COC	-0.023	-0.035	0.011	0.017
R2 Y1	0.545		0.551	
R2 COC	0.001		0.000	
overall χ^2	$\chi^2(4) = 3.891$, $p = 0.421$			
CFI	1.000			
RMSEA	0.000			
SRMR	0.020			

Table 15. Summary table for Analysis III, Outcome goals, COC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The total effect for working with care guides was 0.0224 for patients seen at lower relational coordination sites. The effect was not significant with $z = 1.60$, $p = 0.109$. The

direct CG effect for the low RC group was 0.0224 and not significant (z = 1.60, p = 0.109). The indirect CG effect that is mediated by continuity of care was -0.00002, and statistically not significant (z = 0.03, p = 0.973). The total effect for working with care guides was 0.006 for patients seen at higher relational coordination sites. The effect was not significant with z = 0.46, p = 0.646. The direct CG effect for the high RC group was 0.006 and not significant (z = 0.46, p = 0.644). The indirect care guide effect that is mediated by continuity of care was -0.00004, and was not statistically significant (z = -0.16, p = 0.874).

Working with care guides had no statistically significant effect on the percent of outcome goals met at the end of the study, controlling for percent of goals met at the baseline. This effect was not significant for patients seen at higher relational coordination sites and those seen at lower relational coordination sites. There was no statistical evidence to support a mediating role of continuity of care in predicting outcome goal attainment at the end of the study for both groups.

Results using the UPC and SITE indices as measures of continuity of care did not differ from the results that used the COC index. Table 16 ~21 summarizes the results of the sensitivity analyses.

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.033	0.039	-0.002	-0.002
CG → Y1	0.029*	0.014	0.027*	0.014
UPC				
CG → UPC	-0.015	-0.004	-0.014	-0.004
R2 Y1	0.155		0.188	
R2 UPC	0.001		0.0001	
overall χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.029	0.036	-0.002	-0.003
CG → Y1	0.027*	0.070*	0.014	0.036
UPC				
CG → UPC	-0.014	-0.028	-0.004	-0.007
R2 Y1	0.173		0.177	
R2 UPC	0.0008		0.0001	
overall χ^2	$\chi^2(4) = 3.394$, $p = 0.494$			
CFI	1.000			
RMSEA	0.002			
SRMR	0.032			

Table 16. Summary table for Analysis III, Overall goals, UPC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.154**	0.074**	-0.044	-0.022
CG → Y1	0.049*	0.049*	0.120***	0.120***
UPC				
CG → UPC	-0.014	-0.030	-0.003	-0.005
R^2 Y1	0.509		0.564	
R^2 UPC	0.001		0.006	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution: fully constrained				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.177**	0.087**	-0.033	-0.016
CG → Y1	0.042	0.042	0.110***	0.110***
UPC				
CG → UPC	-0.013	-0.027	-0.003	-0.007
R^2 Y1	0.545		0.552	
R^2 UPC	0.001		0.0003	
χ^2	$\chi^2(4) = 16.911$, $p = 0.002$			
CFI	0.992			
RMSEA	0.061			
SRMR	0.030			
Constrained Solution: final model				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.151**	0.074**	-0.044	-0.022
CG → Y1	0.049*	0.049*	0.124***	0.125***
UPC				
CG → UPC	-0.013	-0.027	-0.004	-0.008
R^2 Y1	0.516		0.552	
R^2 UPC	0.002		0.001	
χ^2	$\chi^2(3) = 6.829$, $p = 0.078$			
CFI	0.998			
RMSEA	0.038			
SRMR	0.028			

Table 17. Summary table for Analysis III, Process goals, UPC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.013	0.014	-0.005	-0.006
CG → Y1	0.023	0.054	0.006	0.014
UPC				
CG → UPC	-0.015	-0.031	-0.003	-0.007
R2 Y1	0.164		0.182	
R2 UPC	0.001		0.00008	
overall χ^2	-0.015			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
UPC → Y1	0.009	0.010	-0.006	-0.007
CG → Y1	0.022	0.052	0.006	0.014
UPC				
CG → UPC	-0.013	-0.028	-0.003	-0.006
R2 Y1	0.175		0.175	
R2 UPC	0.0008		0.00005	
overall χ^2	$\chi^2(4) = 3.115$, $p = 0.539$			
CFI	1.000			
RMSEA	0.000			
SRMR	0.029			

Table 18. Summary table for Analysis III, Outcome goals, UPC

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.036	0.040	-0.038	-0.038
CG → Y1	0.029*	0.073*	0.014	0.037
SITE				
CG → SITE	-0.025	-0.057	-0.063	-0.015
R^2 Y1	0.155		0.189	
R^2 SITE	0.004		0.002	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			

Constrained Solution: fully constrained				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	-0.030	0.031	-0.035	-0.036
CG → Y1	0.030*	0.078*	0.014	0.035
SITE				
CG → SITE	-0.026	-0.063	-0.009	-0.022
R^2 Y1	0.174		0.179	
R^2 SITE	0.004		0.0005	
χ^2	$\chi^2(4) = 10.382$, $p = 0.034$			
CFI	0.959			
RMSEA	0.043			
SRMR	0.084			

Constrained Solution: final model				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.030	0.033	-0.035	-0.035
CG → Y1	0.030*	0.076*	0.014	0.035
SITE				
CG → SITE	-0.025	-0.058	-0.006	-0.016
R^2 Y1	0.174		0.178	
R^2 SITE	0.003		0.0003	
χ^2	$\chi^2(3) = 3.679$, $p = 0.298$			
CFI	0.996			
RMSEA	0.016			
SRMR	0.025			

Table 19. Summary table for Analysis III, Overall goals, SITE

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.137*	0.060*	-0.042	-0.017
CG → Y1	0.050*	0.050*	0.119***	0.120***
SITE				
CG → SITE	-0.025	-0.056	-0.007	-0.017
R^2 Y1	0.507		0.564	
R^2 SITE	0.003		0.0004	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			
Constrained Solution: fully constrained				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.156*	0.065*	-0.042	-0.017
CG → Y1	0.041	0.042	0.110***	0.110***
SITE				
CG → SITE	-0.025	-0.060	-0.010	-0.023
R^2 Y1	0.546		0.553	
R^2 SITE	0.004		0.0006	
χ^2	$\chi^2(4) = 16.390$, $p = 0.003$			
CFI	0.992			
RMSEA	0.059			
SRMR	0.081			
Constrained Solution: final model				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.133*	0.055*	-0.049	-0.020
CG → Y1	0.049*	0.049*	0.124***	0.124***
SITE				
CG → SITE	-0.026	-0.062	-0.010	-0.023
R^2 Y1	0.520		0.554	
R^2 SITE	0.004		0.0005	
χ^2	$\chi^2(3) = 6.967$, $p = 0.073$			
CFI	0.998			
RMSEA	0.039			
SRMR	0.080			

Table 20. Summary table for Analysis III, Process goals, SITE

SRMR is slightly high for the model, but deemed acceptable (Kline, 2011; Hooper et al., 2008)
χ^2 by group not reported because of constraints between groups * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Unconstrained Solution				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.007	0.007	-0.040	-0.037
CG → Y1	0.023	0.054	0.006	0.013
SITE				
CG → SITE	-0.025	-0.057	-0.006	-0.016
R^2 Y1	0.164		0.184	
R^2 SITE	0.004		0.002	
χ^2	$\chi^2(0) = 0.000$, *ns*			
CFI	1.000			
RMSEA	0.000			
SRMR	0.000			

Constrained Solution: fully constrained				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.002	0.002	-0.037	-0.036
CG → Y1	0.025	0.059	0.006	0.013
SITE				
CG → SITE	-0.026	-0.062	-0.009	-0.022
R^2 Y1	0.177		0.177	
R^2 SITE	0.004		0.0005	
χ^2	$\chi^2(4) = 10.329$, $p = 0.035$			
CFI	0.966			
RMSEA	0.042			
SRMR	0.082			

Constrained Solution: final model				
	Low RC (N=852)		*High RC (N=907)*	
	B	β	B	β
End of the Study				
SITE → Y1	0.0005	0.0005	-0.039	-0.035
CG → Y1	0.024	0.056	0.006	0.014
SITE				
CG → SITE	-0.025	-0.057	-0.006	-0.016
R^2 Y1	0.176		0.176	
R^2 SITE	0.003		0.0002	
χ^2	$\chi^2(3) = 3.559$, $p = 0.313$			
CFI	0.997			
RMSEA	0.015			
SRMR	0.021			

Table 21. Summary table for Analysis III, Outcome goals, SITE

χ^2 by group not reported because of constraints between groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CHAPTER FIVE: DISCUSSION

Understanding the relational mechanisms that influence primary care teams and the relevant coordinating processes will be instrumental in identifying the elements that improve care coordination efforts in our health care system. This dissertation theorizes and empirically illustrates that the team is an organizational design to cultivate relationships, thus advancing the understanding of the role of relational systems in coordinating care. This dissertation investigates the mechanisms influenced by the strength and the quality of the relationships that lead to effectiveness of team-based care delivery in chronic disease management. Specifically, I investigated the influence of the care guide model of care, continuity of care, and relational coordination on adherence to guideline-recommended care.

5.1 Findings

5.1.1. Overall adherence to guideline recommended care

Analysis I Analysis I examined whether relational coordination influenced the care guide effect on adherence to guideline-recommended care. When compared to patients receiving usual care, patients receiving team based care with care guides had a positive, statistically significant effect on the percent of goals met at the end of the study, controlling for percent of goals met baseline. This effect was significant for both patients seen at lower relational coordination sites as well as patients seen at higher relational coordination sites. The results of the analysis I demonstrate that care models focusing on relational team processes, such enabled by care guides, may be effective in delivering

guideline-recommended care. The benefit of these models of care can be extended to clinics at any stage of relational coordination.

Analysis II Analysis II examined whether continuity of care mediated the care guide effect on adherence to guideline-recommended care. The total effect of receiving team based care with care guides was significant. The direct effect of working with care guides was significant and very similar to the total effect. The indirect effect of care guides that passes through continuity of care was very small and statistically not significant. The proportion of the total effect mediated was very small. Working with care guides was positively associated with the probability of receiving care that adheres to guidelines for chronic illness, and this direct effect was statistically significant when controlling for continuity of care and goal attainment at the baseline. However, there was no statistical evidence to support the mediating effect of continuity of care on the effective management of chronic conditions through relationship-focused primary care teams.. Sensitivity analyses using the UPC and SITE indices as measures of continuity of care did not differ from the results that used the COC index.

Analysis III Analysis III examined whether the levels of relational coordination would moderate the mediating effect of continuity of care on care guides influence on adherence to guideline-recommended care. Consistent with the result obtained in the analysis II, there was no statistical evidence to support the mediating effect of continuity of care on the effective management of chronic care through relationship-focused primary care teams regardless of strength of relational coordination. Working with care guides had a

positive, statistically significant effect on the percent of goals met at the end of the study, controlling for the goal attainment at the baseline. This effect was significant only for patients seen in lower relational coordination sites. These results contradict the initial expectations that care guide model of team care in clinics with higher levels of relational coordination would have higher continuity of care and subsequently better adherence to guideline-recommended care.

When considering all disease-specific benchmarks as applicable care goals, findings from the analysis I and II suggested that the care guide care model could be beneficial in delivering guideline-recommended care. However, analyses considering relational coordination (analysis I and analysis III) showed mixed results. While the analysis I demonstrated that applying the care guide care model in delivering guideline-recommended care could be beneficial at any stage of relational coordination, the analysis III suggested that it would be beneficial only in clinics displaying relatively low relational coordination. Supplementary analysis was performed to further investigate these incongruent findings. One of the main differences between the analysis I and analysis III was the size of the patient panel. While the analysis I embraced all 2,125 patients enrolled in the study, the analysis III contained 1,759 frequent users who had three or more ambulatory visits during the study year. When the analysis I was replicated using the sub group of patients as in analysis III, care guide effect was similar to that found in the analysis III: for frequent users, working with care guides had a positive, statistically significant effect on the percent of goals met at the end of the study, controlling for the goal attainment at the baseline. This effect was significant only for

patients seen in lower relational coordination sites. Other than being frequent users of health care services, this subgroup of patients was not different in demographics and baseline characteristics from the full sample in the study.

5.1.2. Sub analysis on Process Goals

To better understand how care guide model of care contributes to delivery of high quality chronic care, a series of sensitivity analyses was performed by characteristics of the quality measures - adherence to process and outcome guidelines.

Analysis I Analysis I examined whether relational coordination influenced the care guide effect on guideline adherence across process measures of chronic care. When compared to patients receiving usual care, patients receiving team based care with care guides had a positive, statistically significant effect on process adherence. This effect was significant only for patients seen in higher relational coordination sites, confirming the hypothesis that care guide model of team care in clinics with higher levels of relational coordination would be positively associated with the probability that patients received care that adheres to guidelines.

Analysis II Analysis II examined whether continuity of care mediated the care guide effect on guideline adherence across process measures of chronic care. Working with care guides was positively associated with the probability of receiving care that adheres to guidelines for chronic illness, and this direct effect was statistically significant when controlling for continuity of care and goal attainment at the baseline. Although there is

no statistical evidence to support the mediating effect of continuity of care, there was a significant direct effect of continuity of care on the end of the study process goal attainment. When controlling for care guide effect, higher continuity of care was associated with the probability that patients received care that adheres to guidelines.

Analysis III Analysis III examined whether the levels of relational coordination would moderate the mediating effect of continuity of care on care guides influence on guideline adherence across process measures of chronic care. There was no statistical evidence to support the mediating role of continuity of care in predicting process goal attainment at the end of the study for both groups. When controlling for care guide effect, there was a direct effect of continuity of care in predicting process goal attainment only for sites with weaker relational coordination. The result implies that if patients were receiving care from clinics relatively low in relational coordination, higher continuity of care was associated with better adherence to guideline-recommended care regardless of whether they worked with the care guide teams or received care as usual. Working with care guides was positively associated with the probability of receiving care that adheres to guidelines for chronic illness regardless of the strength of relational coordination in sites of care. Although the benefit of these models of care can be extended to clinics at any stage of relational coordination, the associations between working with care guides and attaining goals that target better process of care was stronger for patients receiving care from clinics relatively high in relational coordination.

5.1.3. Sub analysis on Outcome Goals

Analysis I Analysis I examined whether relational coordination influenced the care guide effect on guideline adherence across outcome measures of chronic care. When compared to patients receiving usual care, patients receiving team based care with care guides had a positive, statistically significant effect on the percent of goals met at the end of the study, controlling for the baseline outcome goal adherence. This effect was significant for both patients seen at lower relational coordination sites as well as patients seen at higher relational coordination sites. The results of the analysis I demonstrate that care models focusing on relational team processes, such as models enabled by care guides, may be effective in meeting guideline-recommended outcome measures. The benefit of these models of care can be extended to clinics at any stage of relational coordination.

Analysis II Analysis II examined whether continuity of care mediated the care guide effect on guideline adherence across outcome measures of chronic care. No detectable effect was found between working with care guides and attaining outcome goals for chronically ill patients. Moreover, there was no statistical evidence to confirm the mediating role of continuity of care.

Analysis III Analysis III examined whether the levels of relational coordination would moderate the mediating effect of continuity of care on care guides influence on guideline adherence across outcome measures of chronic care. No detectable effect was found between working with care guides and attaining outcome goals for chronically ill patients. Moreover, there was no statistical evidence to support the mediating role of

continuity of care in predicting outcome goal attainment at the end of the study for both groups.

Although there was a positive association between working with care guides and attaining goals that target better outcomes of care for all patients enrolled in the study (analysis I), the analyses using the subsample of frequent users did not detect the similar relationship. It is worth noting that the study was only for one year, and many improvements in actual clinical outcomes would need to be sustained for longer to matter.

5.1.4. Summary

The findings suggest that the relationship between receiving team based care with care guides and receiving care that adheres to guidelines for chronic illness may be moderated by relational coordination. When considering the quality measures for chronic care covering both process and clinical outcomes, the care guide model can be effective at any stage of relational coordination. Supplemental analyses considering subgroups of quality measures and patients have shown that the moderation of relational coordination had a differential interactive effect on the effectiveness of care guide based teams. Although the moderating effect of relational coordination was confirmed, the results contradict the initial expectations that relational coordination will amplify the effect of a care guide-stimulated team care model on delivery of guideline-recommended care for chronically ill patients. For frequent users, working with care guides was beneficial only in clinics displaying relatively low relational coordination.

The care guide model of care aimed to create a micro-structure, a team that enables providers, staffs, patients, and care guides to talk to each other and share information relevant to managing patients' health condition.

This dissertation investigates the mechanisms influenced by the strength and the quality of the relationships that lead to effectiveness of team-based care delivery in chronic disease management. Specifically, I investigated the influence of the care guide model of care, continuity of care, and relational coordination on adherence to guideline-recommended care. The results suggest that care models focusing on relational team processes, such enabled by care guides, have differential interactive effect when considering the mediating mechanisms and moderating boundary conditions as they influence the quality of care measures.

5.2 Limitations

It is important to acknowledge the limitations of this study. First, although the strength of the research was having a randomized control design, this presents the possibility of having experimental effects, including Hawthorne effects. However, it should also be noted that the key variables in the study, continuity of care and relational coordination, were calculated a posteriori. Detailed ambulatory visits data during the study period that comprises the continuity of care measures were collected after the study was completed and unknown to the providers, care guides, and patients. In addition, to reduce the potential response bias, the relational coordination survey asked and included the

physicians, nurses, clinical staffs, and care guides to report the behaviors of other functional groups, as respondents are likely to overestimate their own behaviors. Moreover, in order to avoid the problem of retrospective reports, the relational coordination survey asked to describe current care process and working conditions. These have been suggested as ways to lessen the socially desirable responses and retrospective response error (Gittell, 2012).

Adherence to guidelines was instrumented as percentages of goal attained. Because the benchmarks patients were at risk for were disease-specific and condition-specific, the denominator for the measure of percentage of goals met could range from 3 to 12. Accordingly, I acknowledge that the magnitude of the percentage point increase with one additional goal met can be different. I addressed the issue of non-linearity and non-normality inherent in percentage measures methodologically, using asymptotically distribution free estimation methods (ADF). Because of this analytic choice, the result was limited in addressing the non-independence of observations by clustered sampling by clinics. Restrictions in clustering standard errors will not allow for ADF estimation, as well as does not provide overall model fit statistics, but only fit statistics relating to residuals. Based on the recommendation that at least three or more fit statistics should be taken into account to determine the model fit (Kline, 2011), which provides better guidelines for model choices especially for the group constraints the results in this dissertation were based on ADF estimation. Sensitivity analyses of replicating the models with correction for clustered standard errors with maximum likelihood estimation validated that the results did not differ.

The measure of relational coordination proposed by Gittell (2002) suggests four factors that constitute the communication dimension (timely, problem solving, frequent, and accurate) and three factors that constitute the relationship dimension (shared goals, mutual respect, and shared knowledge). In this study, I was able to measure a subset of these factors, excluding the assessment of frequency and accuracy in the communication dimension. I did this in order to reduce the survey respondent burden while measuring the key applicable concept of relational coordination relevant to the care guide model of care. I verified that the measure of relational coordination with selected constructs is similar to the measure of relational coordination with full constructs from prior research.

The measure of relational coordination was collected through the provider survey administered during the intervention. Providers who take on the primary role in care delivery at the five study clinics were invited to provide their assessment of the care guide program and practice in general. Gittell (2012) suggests measuring relational coordination based on a matrix or network methodology, in which each network ties between cross functional groups are evaluated separately. Using a network measure of relational coordination may enhance the accuracy of measurement and presents the possibility of disaggregating the network into each cross-functional tie to identify and explore which of the ties has the greatest influence on the organizational performance or the team effectiveness. This study followed the proposed measurement strategies and verified that the results concurred with pattern of relationships found in relational coordination literature, that relational coordination tend to be higher within same

workgroups and lower between the workgroups. While the advantage of the network methodology is in the ability to assess at the level of dyadic ties, I do not report or draw inferences from the matrix analysis as caution is warranted for the following reason. Due to confidentiality issues raised by IRB, I could not obtain detailed respondent information for the provider survey. As such, I was unable to determine how involved each respondent was in working with care guides in the provision of care. Without the assurance of whether the responses reflect the opinions of those who were actually involved in working with care guides, it was deemed appropriate to consider an alternative way to conceptualize and analyze relational coordination. Because of this constraint, this study explored a unique and creative form to explore the effect of relational coordination. First, the relational coordination score was aggregated to the site-level. This practice, suggested by Gittell (2012), is adopted in most relational coordination studies that employ a regression framework (appendix A). Statistical evidence, including intra-clinic correlations, supported building relational coordination as a clinic-level construct. Aggregation of relational coordination at the clinic level presented an opportunity to conduct group comparisons, because the pattern of relational coordination by each site exhibited clusters of clinics with relatively high or low relational coordination. The instrumentation of relational coordination was intended to measure the climate of team process in the clinics. It should be noted that the addition of care guides to encourage relational care was an organizational change and the effect of care guides will likely traverse across the work practices in primary care offices. As such, there was the potential for it to have spill over effects to providers and other care team members within the study sites. While I was limited in knowing the intensity of the

interactions between the providers and care guides, I assessed relational coordination as part of the organizational climate, and verified that it can be analyzed in such a way.

Moreover, care guides were staffed at five study sites within the system. While general roles and responsibilities were defined, their specific involvement in the provision of care was under the discretion of each individual site. As a result, the care guide model may have been operationalized differently in particular sites. The measure of relational coordination, collected at the site level, might have picked up the different levels of care guide acceptance at the clinic, but it does not provide more nuanced characteristics and work of care guides in the clinics. However, much effort was exerted to standardize the implementation, for example, through the continuous education and monitoring by project managers. Also, conceptually, relational coordination was not a direct evaluation of care guides, but an assessment of the contextual team process. For these reasons, the influence of this limitation on the results is expected to be minimal.

The measure of continuity of care was constructed using the detailed ambulatory visit information during the one-year the patients were enrolled in the study. I obtained these administrative data from the health system: If a patient sought care from the clinics within the system, any encounter data (including the date of the visits, the site of care, and the practicing physician information) were available. In accordance, I was only able to measure continuity of care within the health system. If a patient sought care outside the system, these encounter data were not available. This limitation may have affected the

discrete accuracy of continuity of care measures. Better measures of continuity of care will require detailed encounter data not restricted by organizational boundaries.

This research was conducted in a single, unique setting. Therefore, caution is warranted in generalizing the results. Generalizability is an issue when a study is conducted in a single and unique setting. The care guide model was tested within a single health system in Minnesota. Compared to other states where patients are more diverse and health care services are focused on public health, care in Minnesota is specialty-driven for predominantly white, older patients (United Health Foundation, 2013). In addition, the large integrated health system where the study took place is known for implementing innovative and aggressive quality improvement strategies. It is possible that competing or confounding initiatives might have affected the variables in this study. For example, during the study year, the organization implemented a system-wide initiative on blood pressure control with extensive regular provider feedback. This redundancy is commonly observed as organizations often adopt multiple approaches to improve performance (Argote, 1999). Despite of concurrent and possibly competing quality improvement initiatives in place, the care guide model of care had an effect on attaining better quality measures compared to the usual care. This finding attests to the marginal utility of relational care. In managing chronic disease, a relational approach to coordinating care is desirable even when the possibilities of redundancy exist. In addition, because most of relational coordination literature measures the construct using a 5-point likert scale, it might be hard to apply direct comparison with prior research to the relational coordination scores used in the dissertation. I did find one study that measured relational

coordination using a 4-point likert scale similar to this study (Hartgerink et al., 2014). Compared to relational coordination scores reported in their study (range 2.91~3.12 in three hospital sites), relational coordination scores in the study clinics were consistently higher (range 3.19~3.50 in five primary care clinics). This demonstrates that even in organizations with a positive relational climate, the relative differences in relational coordination may have a conditional effect in determining effectiveness of a care guide team care model on adherence to guideline recommended care. Future research should investigate this moderating effect, whether the findings still hold in organizational context with absolute low relational coordination.

5.3 Contributions and Implications

This study is one of the few studies to explore the impact of relational coordination on quality outcomes in the context of primary care and to my knowledge, possibly the first study to expand the understanding of relational coordination by exploring interventions prospectively designed to develop and enhance quality of relationships in a randomized controlled setting. Seminal work in relational coordination research consists of almost entirely cross sectional, observational studies. Despite the fact that relational coordination has been a popular subject of investigation, there have been no randomized control studies that have purposefully designed an intervention to examine care models that aim to engender positive relationships. This is a common criticism of relational coordination. To date, concepts and entities that give rise to relational approaches to coordinating care have been unclear and unexplored. In this dissertation, I recognize that the opportunities to develop and enhance the efforts to improve care also lie in relational ties, and

conceptualized the strength and quality of the relationship as an integral part of the care process. The results provide empirical evidence about the relative effectiveness of a relationship-focused, team-based approach to improve chronic care.

Earlier results of testing efficacy of care guides were positive. Patients' attainment of care benchmarks improved from 83.8 % at the baseline to 86.6 % at the end of the study for those who worked with care guides, whereas only slight improvements 85.2% at the baseline to 85.5% at the end of the study were observed for the patients who received usual care. The difference between these two patient groups was significant (OR = 1.765, p = 0.021) (Adair et al., 2013). The results from this study expands the understanding of the care guide model by providing insight into the conditions under which a care guide approach to care may be more effective in delivering care that adheres to guideline recommendation.

This dissertation work confirms that a relational systems approach to coordinate care using primary care teams can have a positive influence on delivering chronic care that adheres to guideline recommendations. Results from the first analysis supported that the benefit of working with care guides was positive and statistically significant for attaining disease specific goals for all patients, at any stage of relational coordination. Moreover, similar results were found when I performed sensitivity analyses on goals that target to improve clinical outcomes. In addition, when considering the goals focusing on improving processes of care provisions for all patients enrolled in the study, I found that relational coordination enhanced the care guide effect: When compared to patients

receiving usual care, patients receiving team based care with care guides had a positive, statistically significant effect on process adherence, but only if the care was received in higher relational coordination sites. This has important implications for practice. While some may argue that primary care is inherently delivered by teams, the care guide model embeds a tighter teamlet within the broader scope of the team in the care process with attention to relational mechanisms. Many care coordination efforts have identified relationship as a critical element in identifying the patient's needs and preferences for health services and information sharing. This dissertation advances the understanding of primary care teams with attention to relationships as a primary vehicle for carrying out coordinating activities. Much of health care today is delivered by teams. Teams, especially patient-centered teams, bring forth systems thinking. Teamwork can support the management of chronic disease. It is possible that patients appreciate face-to-face interaction and some may communicate and learn better from peer figures than from authority figures like nurses and doctors. It is also possible that interpersonal feedback positively influence performance (Grant and Parker, 2009). Doctors and nurses may be more responsive to tailored, goal-oriented feedback from team members than impersonal, coercive reminders generated by the EMR. Properly selected and trained laypersons can be a new and relatively inexpensive source of help in a primary care office, and who cultivate relational systems thinking (Adair et al., 2013).

Analysis II examined whether continuity of care mediated the care guide effect on adherence to guideline-recommended care. While the mediation hypothesis was not supported, results from the analysis II attest to the efficacy of the care guide team care

model on adherence to guideline recommended care. When controlling for continuity of care, working with care guides provided a positive and significant effect on adherence to guideline recommended care. The benefit was consistent when I examined the guidelines that recommended better processes of care. However, no detectable effect was found for attaining goals that target clinical outcomes. Although the hypothesis of mediation was not supported, higher continuity of care was associated with meeting the guidelines that recommended better process of care when controlling for care guide effect. This result supports the existing literature on continuity of care: there is room to improve processes of care when greater proportion of encounters is with a patient's primary care physician (Weinick and Krauss, 2000; Forrest and Starfield, 1998).

Analysis III examined whether the levels of relational coordination would moderate the mediating effect of continuity of care between care guides influence on adherence to guideline-recommended care. While I did not find evidence of the mediating role of continuity of care in care pathways, I found intriguing care guide effects when I considered relational coordination. When controlling for continuity of care, benefits of working with care guides was positive and significant only for patients seen at lower relational coordination sites for receiving care that adheres to all applicable guideline recommendations, encompassing both process and clinical outcomes care goals. This finding contradicts the initial expectations that a care guide model of team care in clinics with higher levels of relational coordination will be more effective in adhering to guideline-recommended care. Several implications rest on these findings. First, the result indicates that care models that aim to engender relationships that support team

coordination in managing chronic illness may have no additional benefits if the clinics were already equipped with high relational climate. Teamwork requires considerable coordination and interactive communication among the providers, supporting staffs, and patients. Clinics with higher relational coordination may have work processes that support consistent and coherent management of the patient's health problems in place. It is possible that a care guide approach to coordinating care that supports primary care team coordination in these settings may have had a redundant effect on management of chronic illness. Second, those clinics that did not have a climate of positive relationships can effectively use care guides to engender these relationships. Taken together, these findings underscore the importance of understanding the contextual factors that contribute to quality of care. Successful installation of relationship-focused team care requires an awareness of relational coordination as a contextual condition that can be linked to the effectiveness of the care model. The findings suggest that when considering a relationship-oriented care model, the relational coordination of the organization should be considered to determine the likely relative effectiveness of the approach. This dissertation research demonstrates the potential relevance of conditional factors to coordinating guideline-based care. While my research considered relational coordination as an indicator of moderating boundary conditions, it also should be noted that this group-level construct may be related to other dimensions of organizational climate such as cohesion, change readiness, and organizational support, as well as be reflective of interpersonal behaviors such as communication, heedful interrelating, and respectful engagement (Grant and Parker, 2009; Weick and Roberts, 1993; Dutton, 2003). Relational coordination may serve as a convenient diagnostic tool to determine potential

effectiveness of a team care model, but further study is needed to obtain a better understanding of the key elements that contributes to high quality care delivery.

Interestingly, the results were not consistent with findings that considered overall goals when I conducted a supplementary analysis on subsets of goals that focused on process measures of care. Compared to patients receiving usual care, patients receiving team based care with care guides had better adherence to process measures of guideline recommended care, but only if they were seen in higher relational coordination sites. When controlling for continuity of care, working with care guides provided positive and significant effects on adherence to guideline recommended care regardless of levels of relational coordination, although the effect was stronger in clinics with higher levels of relational coordination. In general, the trends observed when considering process goals supported the hypothesis of positive interactions between care guide model and relational coordination on increased likelihood of care process adherence. Moreover, the findings indicate that, even when clinics are low on relational coordination, care guides can enhance the adherence to guideline recommended care, possibly alleviating insufficient communication and relationship and produce marginal benefits. Use of care guides can be simultaneously beneficial in both levels of relational coordination for process improvement, controlling for the influence of continuity of care. The results demonstrate that the care guide teamlet approach can leverage the positive work process. Several implications can be drawn with respect to the strengthening effect of relational coordination and its relationship to care guide effectiveness on process goal attainment. Relational coordination may be specifying interactions that must exist among

interdependent team members if they are to be effective. For relationship-focused team to successfully coordinate work and improve quality of care delivery, a contextual foundation of high quality communication supported by systems thinking may need to be in place.

In addition, I observed different care guide effects influenced by relational coordination when comparing the results from analysis I and analysis III. One difference between the two analyses was while analysis I used all the patients enrolled in the study, in analysis III I used a subset of the sample, patients who had 3 or more ambulatory visits within the study year due to the instrumentation of continuity of care. When I performed supplemental analyses using the models in analysis I with the subgroup of patients in the analysis III, the care guide effect was consistent with the findings from the analysis III: when controlling for continuity of care, benefits of working with care guides were positive and significant only for patients seen at lower relational coordination sites. I was unable to ascertain the source of differential effect for the frequent users of health care services. The subgroup of patients was not different in demographics and baseline characteristics from the full sample in the study, other than they sought more frequent care in the system. This suggests that further research is needed in identifying the types of patients who would benefit most from working with the care guides.

5.4 Conclusion

This dissertation investigates the role of relationships in the provision of care. A care guide model of care exemplifies a relationship-focused, goal-oriented primary care team

model that seeks to change work processes and organizational structures so that they support more effective communication and teamwork. I conceptualized that care guides, by design, will carry a boundary spanner role that will strengthen relationships and facilitate information exchanges among members of the care team. Serving as an accessible, familiar, and trusted point-of-contact in the health care system, the care guides are a purposeful variation of the care teamlet to foster a sense of team that goes beyond the traditional hierarchical doctor-patient relationships. I observed that care guides had a differential effect on adherence to quality care measures depending on the levels of relational coordination in the sites of care.

The findings suggest that a good fit between the context of coordination and the mechanisms of coordination is required. Understanding the mechanisms that influence the strength and the quality of relationships and lead to improved adherence to guideline recommended care will be instrumental in the design of future care coordination programs. The work presented in this dissertation has important implications for future studies of teamwork and care coordination and provides insights into the use of boundary spanners to cultivate relationships that enhance the team functioning.

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Appendix A. Summary of Findings in Relational Coordination Research

Publications	Objectives	Methods	Key findings in relation to RC
Gittell et al (2000)	▪ To introduce the concept of relational coordination and to determine its impact on the quality of care, postoperative pain and functioning, and the length of stay for patients undergoing an elective surgical procedure	▪ Orthopedic surgery patients and their providers in nine hospitals ▪ Cross sectional survey of patient and provider ▪ HLM	▪ RC between surgeons, nurses, physical therapists and social workers predicted improved quality of care, reduced postoperative pain, shortened length of stay, and improved postoperative functioning ▪ RC contributed to cost savings in caring for joint replacement patients
Gittell (2000)	▪ To address how organizations achieve high levels of relational coordination	▪ Four airlines in nine airport sites ▪ Employee survey, Field observation ▪ Correlation Analysis, Qualitative analysis	▪ RC is the strong indicator of the use of cross-functional liaisons, IT, supervisors, cross-functional performance measurement, employee selection, conflict resolution and flexible work roles ▪ RC is negatively associated with workload of cross role operations agent (boundary spanner) ▪ RC was predicted by selecting for teamwork and cross functional approaches to performance measurement
Gittell (2001)	▪ To test the impact of supervisory span on group process and performance	▪ Four airlines in nine airport sites ▪ Semi structured interviews, Cross sectional survey, Archival measures ▪ Random effects multiple regression analysis, Qualitative analysis	▪ RC between pilots, flight attendants, gate agents, operations agents, mechanism baggage handlers, cabin cleaners, caterers predicted a higher rate of performance outcomes (on time arrivals, fewer customer complaints, fewer baggage mishandling errors) and efficiency outcomes (staff productivity, turnaround time) ▪ Narrow supervisory span achieve higher levels of RC ▪ Performance: gate time per departure, staff time per passenger, customer complaints, baggage handling and late arrivals ▪ Control: flight loading, tons of cargo per flight, passenger connecting per month, average flight length
Gittell (2002a)	▪ To examine the impact of relational coordination between provider-provider on customer satisfaction and intent to recommend compared to customer-provider relationships	▪ Orthopedic surgery patients and their providers in nine hospitals ▪ Patient and Provider Survey, Patient hospitalization records ▪ Correlation Analysis, Random effects linear regression	▪ RC enhanced patient's trust and confidence in the care provider team ▪ Provider - provider relationships positively influenced patients' satisfaction with their care and their intent to recommend ▪ Patient - provider relationship mediates RC and patients' satisfaction with their care and their intent to recommend

Publications	Objectives	Methods	Key findings in relation to RC
Gittell (2002b)	▪ To show how coordinating mechanisms (routines, boundary spanners and team meetings) work	▪ Orthopedic surgery patients and their providers in nine hospitals ▪ Telephone interviews of hospital administrators, Surveys of patients and providers, Patient hospitalization records ▪ Random effects linear regression	▪ Uncertainty increased the impact of care coordinating mechanisms (boundary spanners, team meetings, protocols) and RC on performance outcomes ▪ Positive effect RC on quality performance greater when uncertainty was higher ▪ Coordinating mechanisms on performance outcomes were mediated by RC ▪ Uncertainty moderated performance ▪ Performance outcomes in the context of patient care: Quality of Care, length of stay ▪ When RC is added to each model, the effects of coordinating mechanisms on quality performance become nonsignificant, while RC itself has significant positive associations with quality performance ▪ Coordinating mechanisms enhance (rather than replacing) RC
Gittell and Weiss (2004)	▪ To illustrate and support the model of multi-level (intra- and inter- organizational) coordination mechanisms in patient care	▪ A hospital in Boston ▪ Interview ▪ Case study	▪ Propose that coordination of patient care is a phenomenon best suited for multi-level analysis ▪ RC is proposed as a measure for coordination in such multi-level model (RC not main focus of this study)
Gittell et al (2006)	▪ To identify correlates of airline layoffs post September 11 crisis and examine the role of relational and financial reserves on recovery in the airline industry	▪ Major airlines ▪ Archival data ▪ Correlational analysis, Random effects regression analysis	▪ Layoffs after the crisis strongly correlated with lack of financial and relational reserves ▪ Financial reserves and relational reserves reinforce and enables each other and contribute to resilience during organizational crisis
Weinberg, Gittell, Lusenhop, Kautz and Wright(2007)	▪ To investigate patients' experience with coordination of their postsurgical care across multiple settings and the effects on outcomes	▪ Orthopedic surgery patients and their providers ▪ Provider and Patient surveys (before, 6 and 12 wk post-surgery) ▪ OLS multiple regression	▪ Patients reported problems of coordination globally as well as in discharge, at rehab facility, with home health care, and at follow-up visit with surgeon ▪ At 6 wks post-surgery: coordination problems were associated with greater joint pain, lower functioning, and lower patient satisfaction ▪ At 12 wks post-surgery: coordination problems were associated with greater joint pain, but were not associated with functional status ▪ Time constraints, patient volume, and access to other providers were key barriers to coordination identified by the providers

Publications	Objectives	Methods	Key findings in relation to RC
Weinberg , Lusenhop, Gittell and Kautz (2007)	▪ To explore the caregivers' role in coproduction of care; the effects of coordination between formal providers and informal caregivers on caregiver preparation to provide care at home and the effect of caregiver preparation on patient outcomes	▪ Orthopedic surgery patients and their formal health care providers and informal care givers ▪ Patient survey before and 12 wk post surgery, Caregiver survey 6 wk post surgery ▪ 3 stage least square analysis of structural equation modeling	▪ RC between providers and family members positively predicted functional status, pain ratings, and mental health ratings ▪ RC associated with family member preparation for caregiving and clinical outcomes (functional status, freedom from pain, mental health) ▪ RC has significant effect on post 12 wk pain ratings, functional ratings, and mental health ratings
Gittell, Weinberg, Pfefferle and Bishop (2008)	▪ To examine the impact of relational coordination on employee job satisfaction and quality outcomes	▪ Nursing home residents and nursing aides in fifteen nursing homes ▪ Cross sectional survey ▪ Facility level archival data from CMS ▪ Random effects linear model	▪ RC between nursing aides, nurses, housekeeping, and dietary staff is a significant associated with resident quality of life and nursing aide job satisfaction
Gittell, Weinberg, Bennett and Miller (2008)	▪ To examine the association between job design, RC and work outcomes	▪ Hospitalists and private practice physicians in a single hospital ▪ Cross sectional survey, Patient EMR ▪ One tailed t-tests, Random effects regression analysis	▪ Hospitalist job design predicted higher levels of RC ▪ Hospitalist job design predicted lower LOS, lower total costs of care and lower readmission rates ▪ RC mediated the association between job design and excess LOS ▪ Hospitalist job design allowed greater availability to other members of the patient care team (including nurses, residents, therapists, case managers and social workers) and to their specialization in the care delivery compared to traditional job design
Gittell (2008)	▪ To explore the role that relationships play in enabling resilient responses to external pressures and the organizational practices that enable workers to respond in a resilient way when organizational change is required	▪ Orthopedic units in nine hospitals ▪ Interviews, Site visits, Cross sectional survey, Archival data (to measure managed care penetration) ▪ Random effects regression analysis	▪ External pressure predicted RC among providers in orthopedic units; RC is a resilient response to external threats that require a coordinated collective response across multiple functions or roles. ▪ Managed care penetration predicted higher perceived work stress ▪ Managed care did not predict RC: work stress and relational work system predicted RC; job stress mediated the relationship between external pressure and RC ▪ Workers engage in higher levels of RCwhen they perceive external threats; high performance work system (a relational work system) strengthens this resilient response

Publications	Objectives	Methods	Key findings in relation to RC
Carmeli and Gittell (2009)	▪ To explore the relational underpinnings of learning from failures, and how high quality relationships (relational coordination) foster psychological safety(mediator) and thus enable organizations to learn from failures	▪ study 1: employees from software, electronics and finance industries in Israel, cross sectional survey ▪ study 2: graduate students with full time employment, pre-post survey ▪ Regression analysis, Mediation analysis	▪ study 1: Positive relationship between RC and high levels of learning from failure and psychological safety; partial mediation ▪ study 2: RC predicted learning from failures; full mediation of psychological safety
Bond and Gittell (2010)	▪ To examine the impact of cross-agency collaboration on reentry outcomes	▪ Administrators/managers representing probation, parole, police, employment and substance abuse service agencies in MA ▪ Cross sectional survey, Telephone interviews ▪ Linear regression	▪ Employment and substance abuse service providers are key agents in successful reentry ▪ Resilience: association between relational coordination with employment and substance abuse service providers and increased rates of recidivism over time
Gittell, Seidner and Wimbush (2010)	▪ To examine the relationship between high performance work systems on RC and work outcomes (quality and efficiency outcomes)	▪ Orthopedic surgery patients and their providers in nine hospitals ▪ Administrator interviews, Surveys of patients and providers, Patient hospitalization records ▪ Random effects multiple regression analysis, Random effects Poisson regression	▪ High performance practices(proactive cross functional performance measurement and cross functional rewards) predicted higher levels of RC ▪ RC predicted LOS and QoC ▪ High performance practices did not predict LOS or QoC ▪ Cross role workload of case manager (boundary spanner) negatively associated with RC ▪ RC mediates the association between high performance work system and outcomes; RC as a relational pathway
Havens et al (2010)	▪ To assess nurse perceptions of RC among registered nurses and other providers and the association between relational coordination and patient care quality	▪ Nurses from surgical, medical, intensive care, and emergency units in 5 acute care community hospitals in rural PA ▪ Surveys ▪ Correlational analysis, OLS	▪ RC between nurses and other providers was associated with to overall quality of patient care ; higher levels of RC related to less frequent family complaints, less frequent medication errors, fewer hospital acquired infections, and fewer patient fall-related injuries ▪ RC associated with work outcomes; higher levels of RC related to higher job satisfaction, career satisfaction, professional efficacy, and reduced burnout

Publications	Objectives	Methods	Key findings in relation to RC
Bae, Mark and Fried (2010)	▪ To assess the impact of nursing unit turnover on workgroup processes including relational coordination and patient outcomes	▪ Registered nurses and patients from 268 nursing units at 141 hospitals ▪ Surveys, Archival data ▪ Correlational analysis, Random effects regression analysis, Poisson regression	▪ RC positively associated with patient satisfaction ▪ Work group cohesion positively associated with patient satisfaction; RC had indirect effect ▪ RC associated with high level of medication errors; Authors speculate higher rate of reporting in units with higher RC
McEvoy, Escott, and Bee (2011)	▪ To evaluate a case management service for high intensity service users and association between the quality of the organizational infrastructure, and to identify the factors that influence the development and enhance the quality of the service provision	▪ Case management service in Northern England ▪ Surveys, Interviews ▪ Qualitative analysis	▪ Boundary spanning, resource negotiation and heedful interaction affects care coordination ▪ Patterns of interaction between case managers and their coworkers influenced the scope and quality of care coordination ▪ Clearly defined, task focused, relational workspaces (i.e., integrated coordination networks) support case management activities
Hartgerink et al (2012)	▪ To assess relational coordination among providers and its impact on integrated care delivery to older patients in the hospital	▪ health professionals involved in the delivery of care to older hospitalized patients in the Netherlands ▪ Questionnaires ▪ Correlation analysis, Multiple regression, Paired sample t-test	▪ RC positively associated to delivery of inpatient integrated care ▪ RC was lower between health care professionals in the same discipline ▪ RC was higher between health care professionals in nurses and other discipline ▪ RC higher in geriatrics unit
Cramm and Nieboer (2012a)	▪ To assess relational coordination and its impact on chronic disease management	▪ 19 chronic care programs in the Netherlands ▪ Cross sectional surveys ▪ Correlation analysis, Multiple regression, Paired sample t-test	▪ RC between primary care team positively associated with community linkages, self-management support, decision support, delivery system design, and clinical information system ▪ RC improves over time ▪ RC predicted improvements in chronic care delivery
Warshawsky, Havens, and Knafl (2012)	▪ To examine the influence of interpersonal relationships on work engagement and proactive work behavior	▪ Nurses from acute care hospitals ▪ Survey ▪ Regression analysis, Mediation analysis	▪ RC enhanced work engagement ▪ RC enhanced proactive work behaviors

Publications	Objectives	Methods	Key findings in relation to RC
Cramm and Nieboer (2012b)	▪ To assess relationship between relational coordination, the quality of care, and disease management for chronic care delivery	▪ 22 primary care practices in the Netherlands ▪ Questionnaires ▪ Paired t-test, Random effects regression analysis	▪ RC predicted the quality of chronic care delivery ▪ quality of chronic care delivery improved over time ▪ RC improved over time ▪ administration and management had a positive effect on chronic care delivery
Warfield et al (2013)	▪ To investigate the effect of the collaboration between state providers and family caregivers on family well-being	▪ Families participating in autism waiver services ▪ Surveys, Archival data ▪ Hierarchical OLS, Nested logistic regression	▪ Family's view on provider coordination significantly associated with parenting stress and family functioning ▪ Higher levels of RC between families and state providers predicted lower parenting stress and positive family functioning
Noel et al (2013)	▪ To explore the impact of relational coordination and reciprocal learning on quality outcomes and elements of Chronic Care Model in the context of primary care	▪ 39 community based primary care practices in TX ▪ Surveys ▪ Hierarchical linear regression	▪ RC between primary care team predicted higher scores on the assessment of chronic illness care ▪ EHR use in primary care team predicted higher scores on the assessment of chronic illness care
Cramm, Hoeljmakers and Nieboer (2013)	▪ To examine the influence of relational coordination on satisfaction with the care delivered by community health nurses to community-dwelling frail people	▪ Health professional working with community health nurses ▪ Cross sectional survey ▪ Correlation analysis, Random effects multiple regression, Paired sample t-test	▪ RC higher with community health nurses than with other primary care providers ▪ RC was significant in predicting satisfaction with the care delivery
Manski-Nankervis et al (2014)	▪ To explore roles and relationships between health professionals in diabetes treatment	▪ Providers involved in insulin initiation ▪ Semi structured interviews ▪ framework analysis	▪ Diabetes nurse educators and practice nurse, improved RC identified to support clinical task of insulin initiation for treating diabetic patients ▪ 4 themes related the roles and RC: 1) ambiguous roles, 2) uncertain competency and capacity, 3) varying relationships and communication, 4) developing trust and respect
Appendix. Summary of Findings in Relational Coordination Research			