Relationships between Nursing Unit Contextual-Structural Fit and Unit-level Patient Outcomes

Wei-Ting Lin

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Approved by:

Donna S. Havens

Barbara A. Mark

Gwen Sherwood

Shoou-Yih Daniel Lee

John Carlson

Abstract

Wei-Ting Lin: Relationships between Nursing Unit Contextual-Structural Fit and Unit-level Patient Outcomes
(Under the direction of Donna S. Havens)

The purpose of this research was to answer two questions: What are the relationships among contextual (unit size, workload, support service availability, work complexity and patient acuity) and structural (relational coordination) fit and effectiveness (length of patient stay and number of severe medication errors) on medical-surgical nursing units in acute care hospitals? Second, what are the relationships among relational coordination as a structural variable and length of patient stay and number of severe medication errors as manifestations of effectiveness? This study was guided by structural contingency theory which suggests that structure influences effectiveness and that organizational effectiveness depends on the congruence or fit between context and structure.

This study was conducted using data from the Outcomes Research in Nursing Administration-II study (B. Mark, principal investigator). The sample was 285 nursing units at 144 hospitals across the U.S. Mixed models were tested to analyze the data for patient length of stay. Negative binomial models were tested to analyze the data for severe medication errors. The fit between workload and quality of relational coordination was the only statistically significant finding. The result indicated that, when workload was high, higher quality relational coordination was associated with longer lengths of patient stay. Although statistically significant, the direction of this relationship was opposite of that

hypothesized. Continued research is needed to better understand the relationship between contextual-structural fit and effectiveness on nursing units in acute care hospitals.

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STATEMENT OF THE PROBLEM

Evidence during the past two decades of insufficient quality and high cost has resulted in intense public scrutiny of the United States (U.S.) health care system. In a 2007 study sponsored by the Commonwealth Fund, the U.S. ranked last in health care accessibility, effectiveness, and equity compared to Australia, Canada, Germany, New Zealand and the United Kingdom (Manchikanti & Giordano, 2007). Yet, U.S. health care expenditures are significantly higher than those in other developed countries. In 2005, the cost of health care in the U.S. was 15.3% of the gross domestic product (GDP) or about $6,697 per person (OECD, 2007). In comparison, the United Kingdom spent 8.3% of its GDP or approximately $ 2,724 per person for health care. Similarly, Canadian health care spending in 2005 was 9.8% of its GDP or around $3,326 per person (OECD, 2007).

Length of hospital stays raises important concerns about the quality and cost of health care in the U.S. These concerns are based on the argument that hospital stays often are artificially prolonged due to inefficiencies in the delivery of care. In a study sponsored by the Commonwealth Fund, for example, it was estimated that hospitalizations in the U.S. could be reduced by 30 - 47%, with cost savings of $2 to $5 billion each year, if all states achieved the lowest possible level of admissions and readmissions (Zigmond, 2007). Similarly, the quality and cost of health care in the U.S. can be attributed in part to the incidence of adverse events during hospitalization. In 1999, the Institute of Medicine (IOM)

(Kohn, Corrigan, & Donaldson, 1999) reported that the annual cost of these events, including costs associated with lost income, lost household production, disability, and increased need for health care services approximated $37.6 to $50 billion. More specifically, the cost of treating a potentially preventable adverse event like medication errors was between $17 to $29 billion. When using the lower estimate, the cost of all adverse events, including medication errors as a preventable adverse event, was estimated at 2 - 4% of U.S. health expenditures in 1996.

During the past two decades, substantial research has been done to investigate factors that are associated with hospital quality and efficiency. Despite these efforts, the number of medication errors as an indicator of quality and the length of hospital stays as an indicator of efficiency continue to be areas of concern. In general, two approaches have been typical of the research to investigate concerns like medication errors and prolonged hospital stays. First, researchers have conducted studies at the individual unit of analysis to identify specific patient populations that are at high risk for these outcomes. Second, researchers have investigated isolated work environment or human factors that are thought to contribute to the causation of prolonged length of stay or medication errors. For example, some researchers focus on isolated attributes of the work environment that are thought to have direct implications for prolonged length of stay. Others argue that characteristics of the hospital environment like fragmentation of care and inconsistent contact with the same providers contribute to longer hospital stays. Specifically, Reason's theory has been used to examine work setting factors that increase the potential for human error. For these reasons, much of the research on hospital quality and efficiency has been criticized for failing to consider the organization as a complex entity in which multiple interrelationships exist between characteristics of work environment and the work processes that are needed to achieve desired patient outcome. Further, this research has been criticized because it is inadequate to explain the mechanisms through which work processes interact with characteristics of the work environment to result in desired outcomes.

These criticisms suggest the need to investigate health care quality and efficiency using a theoretical perspective that accounts for the complexity in health care organizations. This perspective is offered in structural contingency theory (SCT), a well established theory that has been used for the past 25 years to investigate organizational performance. Three key concepts are identified in this theory: context, structure and effectiveness (Donaldson, 2001). Context can be defined as inputs to the organization that determine the work activities are needed to transform these inputs to outputs. Structure can be defined as the administrative mechanisms that are used to organize and coordinate work activities. Effectiveness can be defined as the ability of the organization to effectively and efficiently transform inputs to outputs and, thus, achieve its goals. Structural contingency theorists propose that context influences structure and structure influences effectiveness. Further, SCT is based on the premise that organizational effectiveness depends on the congruence or fit between context and structure. Therefore, SCT proposes that there is no single best way to structure the work in an organization so that effective and efficient performance can be achieved. Rather, the best approach for structuring work in an organization is contingent upon the environmental context in which the work is completed.

The concept of fit is not only central to SCT but it also provides the framework within which complexity can be incorporated when investigating organizations and how they perform. Yet, few studies have examined the fit between context and structure or the relationship between contextual-structural fit and organizational effectiveness in health care organizations. Therefore, the purposes of this study were to describe the relationship between structure and effectiveness and relationships among contextual and structural fit at the nursing unit level and unit level performance in terms of quality and efficiency. Specifically, the following research question was proposed: What is the relationship between contextual (unit size, workload, support service availability, work complexity and patient acuity) and structural (relational coordination) fit and effectiveness (length of patient stay and number of unit-level medication errors) on medical-surgical nursing units in acute care hospitals?

Background and Significance

Action has been taken during the past two decades to address concerns about health care quality and cost. These actions include, for example, formation of the Committee on the Quality of Care in America to draw attention to potentially effective quality improvement initiatives as well as fund studies to investigate health care quality and cost and how they can be improved (Becher & Chassin, 2001; Schuster, McGlynn, & Brook, 1998). Despite such efforts, the IOM again reported in 2001 that inadequacies in the health care system remain a serious public health concern and argued that the health care industry has made insufficient progress in consistently providing high quality care at a reasonable cost. In particular, underuse, overuse and misuse were described as three key problems in clinical care, and the need for significant improvement in the following six major areas was identified: safety or avoiding harm to patients; effectiveness in terms of providing treatments that are beneficial while avoiding treatments that are unnecessary or ineffective; patient-centeredness or providing care that respects the preferences, needs, and values of each individual patient;

timeliness in terms of reducing unnecessary delays in treatment; efficiency or appropriately utilization of health care resources, including equipment, supplies, and the ideas, energy, and time of health care providers; and, equality in terms of insuring that high quality and affordable care is available without regard to gender, ethnicity, geographic location, and socioeconomic status.

Reducing prolonged hospital stays is consistent with the IOM goal of increasing health care efficiency. The duration of hospitalization can be affected by numerous factors like patients' prior health status, age, illness severity, and insurance coverage as well as failure to provide services that are needed or recommended (Hayward, Asch, Hogan, Hofer, & Kerr, 2005). However, there is little question that hospital stays can be prolonged unnecessarily (Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002; Zigmond, 2007; Zhan & Miller, 2003). For this reason, length of hospital stay can be viewed as a measure of health care efficiency. Similarly, medications are the most frequent treatment provided to patients during hospitalization. On average, every patient receives at least ten medication doses during each hospital day (Barker, Flynn, Pepper, Bates, & Mikeal, 2002). For this reason, reducing the number of medication errors during hospitalization is consistent with the IOM goals of improving health care quality and safety because medication errors can result in substantial harm to patients.

Patients' Length of Stay

Two major issues can contribute to prolonged hospitalizations. First, some hospital care may be unnecessary. In fact, it has been estimated that 13.5% of all hospital stays are unnecessary (Cary, Sheth, & Braithwaite, 2005). Second, avoidable adverse patient events increase the length and, thus, cost of hospitalization. In a study of patients admitted to an orthopedic surgical unit, researchers estimated the cost of a single day of hospitalization at approximately $1, 265 per patient (Whitehouse et al., 2002). These researchers compared patients who developed an infection during hospitalization with those who did not and found that length of stay for patients with an infection was, on average, 14 days longer and added about $17,708 to the cost of hospitalization. Similarly, Zhan and Miller (2003) investigated adverse events associated with 944 acute hospital stays in 28 states. They concluded that postoperative wound dehiscence extended hospitalization by 9.42 days and added $40, 323 in hospital charges which is approximately $4,280 per day. They further found that infection attributable to hospitalization was associated with 9.58 additional hospital days, at a cost of $38,656 or $4,031 per day. In addition, Ashby, Guterman, and Greene (2000) found a strong link between shorter lengths of hospital stay and slower growth in health care expenditures. These data suggest that hospital stays can be shortened and expenditures reduced both by preventing avoidable adverse events and maximizing quality of care.

Medication Errors

Three terms are used to describe events that occur with medication administration during hospitalization: medication errors, adverse drug events and preventable adverse drug events. Medication errors can be defined as any error that occurs during the process of prescribing, transcribing, dispensing, and administering a medication (Bates, Boyle, Vander Vliet, Schneider, & Leape, 1995a). For example, if the correct medication dosage is not given or if a patient fails to take a prescribed drug, these are all considered to be medication errors (IOM, 2006). On the other hand, adverse drug events refer to any injury or harm that is caused by a medication that was not administered in error (Bates et al., 1995b). For example, if an allergic reaction occurs in response to a medication given to a patient who does not know that he/she is allergic to that medication (IOM report, 2006), this would be considered an adverse drug event but not a medication error. Lastly, preventable adverse drug events are defined as injuries that result from a medication error (IOM, 2006). Based on these definitions, not all medication errors lead to adverse drug events and not all adverse drug events are preventable.

Medication errors not only adversely affect quality of health care, they also can cause death. Phillips, Nicholas and Glynn (1998) estimated that medication errors accounted for about 7,000 deaths in 1993. In 2006, the IOM suggested that at least 1.5 million people are harmed every year by medication errors. Barker et al. (2002) studied 36 different hospital facilities and found a medication administration error rate of 11 percent, excluding doses administrated outside the schedule time. They concluded that a hospital patient usually experiences at least one medication administration error each day. This estimate is comparable to that identified by the IOM which reported in 2006 that a hospitalized patient is subject to at least one medication error per day. Adverse drug events and preventable adverse drug events also increase health care expenditures and adversely affect quality of care. It has been estimated that preventable adverse drug events occur at least 1.5 million times each year in the U.S. (IOM, 2006). In addition, Bates et al. (1997) conservatively suggested that the annual incidence of preventable adverse drug events during hospitalization was 400,000 and estimated the cost for an inpatient preventable adverse drug event at $5,857. Further, these researchers estimated that the extra cost to hospitals associated with adverse drug events is about $5.6 million annually and, for preventable adverse drug events, about $2.8 billion annually (Bates et al., 1997).

Reducing Hospital Length of Stay and Medication Errors

Researchers suggest that the highly complex and interdependent nature of the work in hospitals plays an important role in contributing to prolonged lengths of hospital stay and more medication errors (Sexton, Thomas, & Helmreich, 2000; Wageman, 1995). According to Thompson (1967), there are three types of interdependence work flows in organizations: pooled, sequential, and reciprocal. Reciprocal interdependence, which is most characteristic of hospitals, is seen when work is passed back and forth among people who hold different positions in the organization and make distinct yet complementary contributions to work completion. Following Thompson's original classification of work flows in organizations, other researchers added team interdependence which refers to situations where work is completed through the simultaneous actions of a network of people who hold different positions in the organization (Cheng, 1976; Ven de Van, Delbecq, & Koenig, 1976; Victor & Blackburn, 1987). Team interdependence is similar to, yet more complex than, reciprocal interdependence because the notion of team interdependence suggests that multiple providers are engaged in reciprocal workflows at the same time. As such, the delivery of patient care in hospitals can be described as a function of work flows that are both reciprocal and team interdependent (Garman, Leach & Spector, 2006; Tschan et al., 2006).

Patient care is complex and requires substantial coordination of work activities since each patient's medical history, physical status, psychological status, and social support network are different and can only be addressed effectively through the input provided by multiple providers. Further, many procedures performed in hospitals depend on teams, and, thus, patient care depends on close coordination among professional health care providers (Tschan et al., 2006). All health care professionals, including physicians, nurses, pharmacists, and respiratory therapists, have unique educational preparation and often diverse perspectives on how care should be provided and the care delivery processes that are needed to insure effective care (Garman et al., 2006). For this reason, hospital nurses typically engage in reciprocal interactions with multiple providers, each of whom bring different yet complementary perspectives that contribute to the effective delivery of patient care.

When work flow is complex and highly interdependent, high quality interpersonal interactions are essential to insure performance effectiveness (Cheng, 1976; Thompson, 1967; Ven de Van et al., 1976; Victor & Blackburn, 1987). In other words, when work flow is highly interdependent, greater emphasis must be given to work coordination (Galbraith, 1972, Perrow, 1967; Thompson, 1967; Van de Ven et al., 1976). Consequently, the approaches used to coordinate the work in hospitals are critical to the delivery of care that is not only safe and effective but also insures appropriate utilization of health care resources (Garman et al., 2006; Gittell, 2002; Ingersoll & Schmitt, 2004). In fact, failure to adequately coordinate work flow may create conditions under which prolonged hospitalizations and medication errors are more likely to occur. For example, several researchers have suggested that interprofessional coordination may contribute to not only fewer medication errors but also shorter lengths of hospital stay (Gittell, 2001; Landon et al., 2004; Sexton et al., 2000; Van de Ven et al., 1976). Further, the Institute of Medicine Report, *Keeping Patients Safe* (2004), identified interprofessional coordination as central to the goal of reducing medication errors and called for the development of comprehensive strategies that support greater coordination among health care providers. Therefore, there is emerging recognition that the challenges of reducing patients' length of stay and medication errors may well depend on the extent to which providers from multiple disciplines can work together as an effective team (Garman et al., 2006; Ingersoll & Schmitt, 2004).

Although work coordination has been recognized for many years as an essential component of organizational effectiveness, it was originally described from the perspective of work flow control and work standardization. Over time this perspective has broadened to include consideration of interpersonal communication and group interactions as components of coordination. Consistent with this changing perspective, Gittell introduced the concept of relational coordination as an effective approach to coordination when work is complex and interdependent. Relational coordination can be defined as an approach that involves shared understanding of the work and the context in which it is carried out. Specifically, Gittell argued that relational coordination involves high quality communications that are frequent, timely, accurate, and focused on problem-solving and high quality relationships characterized by shared goals, shared knowledge, and mutual respect. Specifically, Gittell builds on the more general conceptualization of inter-professional coordination by providing greater specificity in describing how the connections among work group members contribute to effective team performance.

Relational Coordination

The concept of relational coordination is relevant to this study because the ability of health care providers to effectively coordinate work activities may have implications for reducing length of hospital stays and medication errors (Gittell, 2002; Ingersoll & Schmitt, 2004; Sexton et al., 2000; Tam et al., 2005). Relational coordination offers an approach that can be used to manage the interdependence and complexity in work settings where patient goals can be achieved only through the effective functioning of a multidisciplinary group of providers. Relational coordination not only integrates or links together different health care professionals' opinions and actions during the delivery of patient care, it also extends beyond interprofessional communication and coordination to emphasize the importance of strong connections among interdependent providers (Gittell, 2002).

Gittell (2003) identified four dimensions of high quality communication: frequent, timely, accurate, and problem-solving. Frequent communication increases providers' familiarity with others' working style and the responsibilities they have which enhances connections among health care professionals. High quality communications also must be timely because communication delays can result in errors or unnecessarily postpone needed treatments. Accuracy is essential to high quality communication because it decreases the potential for errors and fosters effective group processes. Finally, communication quality is critical to the ability of interdependent work teams to engage in effective group problem-solving. Each of these characteristics of high quality communications have implications for hospital effectiveness in terms of fewer medication errors and shorter lengths of hospital stay (Waller, 1999).

Gittell (2003) defined high quality relationship in terms of shared goals, shared knowledge, and mutual respect. Work teams that share common goals are better able to build powerful connections that allow team members to both transmit and effectively respond to critical information. Gittell used the term shared knowledge to suggest that all team members bring unique, yet complementary, knowledge to the patient care situation. By sharing their knowledge, team members can better address patients' needs and achieve desired patient outcomes. Finally, mutual respect describes the type of interactions that must exist among interdependent teams if they are to be effective.

In summary, it is probable that achieving meaningful reductions in the number of medical errors and the length of hospital stays will depend on identification of approaches to coordination that are best suited to the environmental and technological contexts in which hospitals operate. Although relational coordination contributes to a better understanding of how interdependent work processes can be effectively coordinated, linkages between relational coordination and indicators of organizational effectiveness in hospitals have not been adequately explored. Further, few researchers have studied the relationship between structure in terms of work coordination and effectiveness in hospitals or examined the role of contextual contingencies in affecting the relationship between organizational structure and effectiveness. For this reason, little is known about the conditions under which relational coordination is most likely to contribute to desired outcomes, particularly among health care organizations. In the absence of this research, there has been little information to guide the development of strategies that contribute to better patient outcomes by strengthening relational coordination among health care providers.

Chapter Summary and Organization of Dissertation

In Chapter 1, the quality and cost of health care in the United States were identified as major areas of public concern. The importance of coordination among members of the health care team was identified as a factor with the potential to improve health care quality and efficiency. In particular, the importance of relational coordination as an approach that is most likely to be effective with professional providers was presented. An overview of structural contingency theory as the guiding framework for this study was presented. Finally, the study purpose and broad research questions were identified. In Chapter 2, a more detailed discussion of structural contingency theory will be provided. In Chapter 3, a synthesis of the literature on work coordination, focused specifically on interprofessional collaboration, teamwork, and relational coordination will be presented. In addition, research hypotheses for this study are presented. The study research methodology is described in Chapter 4, with study results presented in Chapter 5. Finally, discussion of the results, conclusions based on the study findings, and implications for theory development, future research, and practice are presented in Chapter 6.

CHAPTER 2

THEORETICAL FOUNDATION

In this chapter, an overview of SCT as the guiding framework for this study is presented followed by an in-depth discussion of context, structure and effectiveness as key SCT constructs. Following this discussion, uncertainty and information processing will be presented as summary concepts that connect context, structure, and effectiveness. Fit between context and structure, seen as a central component of SCT, will be described along with approaches that have been recommended to evaluate fit. This chapter ends with a summary of studies that examined relationships between structural and contextual fit and organizational effectiveness.

Overview of Structural Contingency Theory

During the first half of the 20th century, classical organization theory served as the dominant perspective for understanding how work in organizations is done. Two basic assumptions were central to this perspective. First, classical theorists argued that job tasks could be systematically analyzed to determine the best way to complete work assignments. This argument was best reflected in the work of Fredrick Taylor who, using principles of scientific management, segmented tasks into discrete steps which then were sequentially ordered to achieve maximum efficiency. Second, classical theorists argued that, along with one best way to complete job tasks, there was one single best way to structure the work in an organization to achieve optimal performance. In other words, classical organizational theory was based on the assumption that an ideal approach to structure could be identified and universally applied in all organizations to achieve optimal performance.

In the late 1950s and early 1960s, the idea of a single approach to organizational structure gradually shifted to a more complex perspective in which organizations began to be described as open systems that interact with and must adapt to the context in which they operate (Child, 1975). First described as “contingency theory” by Lawrence and Lorsch in 1967, SCT is based on two key assumptions. First, there is no single best way to structure or organize the work in an organization. This premise rejected the assumption of classical organizational theorists that a single approach to organizing work could be successfully applied to all organizations. Second, different approaches to organizational structure are not equally effective (Galbraith, 1973; Scott, 2003). Rather, an effective structure depends on contingencies that arise from the organization’s environment (Pfeffer, 1978). Therefore, SCT theorists offered an alternative to classical organization theory by suggesting that there is no single best way to structure work in an organization but, rather, multiple structures that can be equally effective when they are matched to the contextual contingencies that are faced by the organization (Betts, 2003; Ford & Slocum, 1977; Galbraith, 1973; Ifinedo, 2007; Ifinedo & Nahar, 2009; Peterof & Reed, 2007; Scott, 2003; Shafritz & Ott, 1996; Tosi & Slocum, 1984; Weill & Olsen, 1989; Zott & Amit, 2007). Further, SCT theorists argued that certain structural forms are preferred in some contexts but can be counterproductive in others, meaning that a structural form can result in optimal performance in one organization but have no effect or even reduce performance in another organization (Pennings, 1975).

Despite over 50 years of research, consistent empirical support for SCT is equivocal. The difficulty that researchers have encountered in their efforts to investigate SCT can be attributed, in large part, to the considerable confusion and disagreement that exists about the conceptualization of context, technology, and structure. As illustrated in the tables developed for this chapter, the same concepts not only have been described using different conceptual definitions but different concepts also have been described using the same conceptual definition. However, two consistent themes can be identified from the structural contingency literature. First, structure is contingent on demands that arise from the organization's environment. Second, structure is contingent on the technology that is used to transform inputs into outputs. Taken together, technology and environment are seen as manifestations of the larger organizational context in which the organization operates (Versloot, De Jong, & Thijssen, 2001) and provide the basis for the key proposition of SCT that optimal organizational effectiveness depends on the "fit" between context (environment and technology) and structure (Donaldson, 2001). Broadly speaking, context in terms of the environment can be defined as inputs to the organization that determine how work is completed. Context in terms of technology can be defined as the work processes that are required to transform inputs to outputs. Structure can be defined as the administrative strategies that are used to organize and coordinate work activities. Structure is a key factor in determining how information is communicated both within and outside the boundaries of the organization, how and by whom decisions are made, and how the production of goods or services is divided among workers (Ambrose & Schminke, 2003; Hollenbeck et al., 2002; Pugh, Hickson, Hinings, & Turner, 1968). Finally, although multiple definitions of effectiveness have been described in the literature, effectiveness is defined in this study as the ability of an organization to successful achieve its goals. The major SCT concepts are diagrammed in Figure 1. A detailed discussion of each of these concepts is provided below.

Organizational Context

Environment. This concept includes both the external and internal environment of the organization. The *external environment* includes factors that exist outside the boundaries of the organization but are relevant to organizational goal attainment like industrial and governmental regulations, characteristics of users of organizational outputs, consumer demand for products or services, sources of inputs to the organization, accessibility to suppliers, and flexibility in financial markets (Charns & Schaefer, 1983; Osborn & Hunt, 1974). Burns and Stalker (1961) are recognized as the first to identify the external environment as a structural contingency. Using case study methodology to investigate the implications of technological and market changes for 20 electronic companies in Great Britain, these researchers found that the structure in effective organizations differed depending on attributes of the external environment. Organizations operating in a stable environment were more likely to use a mechanistic structure in which work activities were coordinated through centralization, formalization, and hierarchical authority. In contrast, organizations operating in a dynamic and rapidly changing environment were more likely to use an organic structure in which work coordination was achieved through decentralized decision-making and adaptive work processes.

Many early SCT researchers investigated contextual contingencies that arose from the external environment. Table 1 provides a list of concepts that have been studied as manifestations of the external environment along with their definitions. These concepts can be broadly grouped into four major categories: environmental complexity, environmental variability, inter-organizational interactions, and environmental favorableness. With the exception of environmental complexity, these categories were identified by Osborn et al.

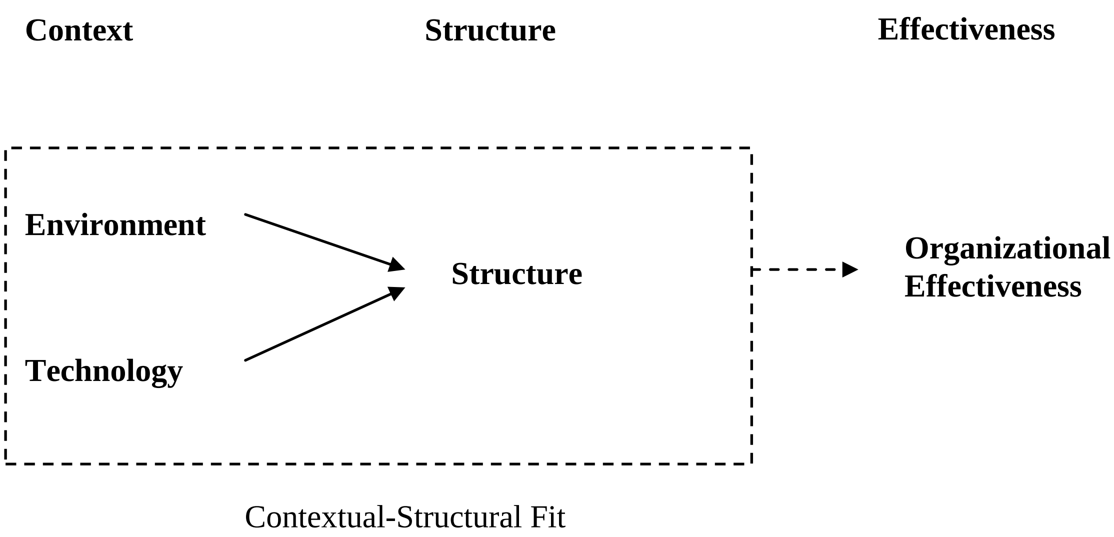

Figure 1. Structural contingency theory

(1980) as dimensions of the external environment. Environmental complexity can be defined as the number and variety of external factors that affect the organization. Osborn et al. (1980) defined environmental variability as unpredictable fluctuations in environmental conditions, inter-organizational interactions as the extent to which the focal organization must interact with other organizations to achieve its goals, and environmental favorableness as the extent to which the external environment provides conditions that are favorable to the organization.

Lawrence & Lorsch (1967), along with Duncan (1972a), were among the first to differentiate the external from the *internal environment* of an organization. Lawrence and Lorsch (1967), in particular, argued that complex organizations are segmented into distinct yet complementary subsystems. Although all organizational subsystems interact with and are affected by relevant segments of the external environment, they also are isolated from many of the external factors that affect the larger organization. However, each subsystem has an internal or domain-specific environment that can be defined as the physical and social factors within the boundaries of the organization that are relevant to the process of transforming inputs to outputs (Stoelwinder & Charns, 1981). The internal environment at the subsystem level is seen as especially relevant since it is the level at which the transformation of inputs to outputs occurs. For this reason, factors in both the external and internal environments are recognized as sources of contingencies that are relevant to structure and, ultimately, performance (Duncan, 1972a; Lawrence & Lorsch, 1967; Leatt & Schneck, 1982). Table 2 summarizes concepts and their definitions that have been used to specifically investigate the internal environment. In Table 3, concepts that have been or can be used to investigate the external or internal environment are listed with their conceptual definitions.

Table 1

Summary of Concepts Used as Manifestations of the External Environment

Concepts	**Definitions**
	Environmental Complexity
Environmental Complexity	Number and variety of external factors that affect the organization (Osborn et al., 1980)
	Extensiveness and heterogeneity of activities outside the organization that are relevant to its operation (Child, 1974)
	Extent that the organization must keep track of heterogeneous actors and a range of activities, linkages, & interactions outside the boundaries of the organization (Anderson & Tushman, 2001)
	The interaction of risk, dependency, and interorganizational relationships (Osborn & Hunt, 1974)
Environmental Density	Number and variety of organizations that comprise the focal organization’s environmental set (Starbuck, 1976; Dess & Beard, 1984)
	Number of organizations in the focal organization’s environment (Anderson & Tushman, 2001)
	Concentration or dispersion of organizations that comprise the focal organization’s external environment (Aldrich, 1972)
Environmental Diversity	Range of environmental activities in which the organization is involved (Leblebici & Salanick, 1981)
Information Load	Amount of environmental information that must be processed by the organization (Huber, O’Connell, & Cummings, 1975; Streufert & Driver, 1965)

Table 1 (continued)

Concepts	**Definitions**
Environmental Heterogeneity	Number and diversity of external factors affecting the organization (Bourgeois, 1980)
	Extent that environmental elements are similar to or different from one another (Dill, 1958; Thompson, 1967)
	Geographic concentration of similar organizations (Aldrich, 1972)
Environmental Variability	
Demand Uncertainty	Degree that realized industry demand and/or resources diverge from the level predicted (Anderson & Tushman, 2001)
Environmental Volatility	Rate of change among activities that are characteristic of the external environment (Leblebici & Salancik, 1981)
	Rate of fluctuation in revenues and expenditures (Tosi, Aldag, & Storey, 1973)
Environmental Turbulence	Degree of change in the external factors affecting the organization (Bourgeois III, 1980)
Inter-organizational Interactions	
Market Diversity	Extent that markets are similar to or different from one another (Mintzberg, 1979)
Environmental Turbulence	Degree of interconnection among environmental elements (Aldrich, 1972; Emery & Trist, 1965; Pfeffer & Salancik, 1978; Terreberry, 1968)
Environmental Risk	Homogeneity or heterogeneity of interacting organizations that affect goal attainment by the focal organization (Osborn & Hunt, 1974)

Table 1 (continued)

Concepts	Definitions
Environmental Interaction	Ability of the organization to develop favorable relationships with other organizations (Osborn & Hunt, 1974)
Organized/Unorganized	Extent that sectors in the environment are bound by formal rules and role sets (Jurkovich, 1974)
Environmental Favorableness	
Environmental Stress	Degree of threat imposed by the external environment (Khandwalla, 1970)
Environmental Illiberality	Degree of threat imposed by the external environment from competition, hostility, or user indifference (Child, 1972a, 1972b)
Competitive Threat	Level of competition that can increase inter-firm rivalry, decrease customer loyalty, and increase competition for resources (Sharfman & Dean, 1991)
Resource Dependency	Importance of a resource to the organization and the sources from which it is available (Dess & Beard, 1984)
Environmental Capacity	Extent to which the environment permits organizational growth and stability and allows procurement of needed resources (Aldrich, 1972)
Environmental Munificence	Extent to which the environment supports sustained organizational growth (Dess & Beard, 1984; Starbuck, 1976)
	Extent that available resources are plentiful or scarce (Anderson & Tushman, 2001)
	Extent that the environment provides sufficient resources for the organization (Sharfman & Dean, 1991; Aldrich, 1972; Starbuck, 1976)

Table 1 (continued)

Concepts	**Definitions**
Domain Consensus	Extent of competition for needed resources (Aldrich, 1972)
Environmental Hostility	Availability of and competition for resources (Mintzberg, 1979)

Technology. Technology has been defined as the "actions that an individual performs on an object, with or without the aid of tools or mechanical devices, to make some change in that object" (Perrow, 1967, p. 195). Woodward (1958) is credited as the first to identify technology as a structural contingency. In a study of 100 manufacturing organizations, Woodward (1958) found that structural features like levels of authority, span of control, formalization, and standardization varied according to the complexity of the technological processes that were used to transform inputs to outputs. Among organizations using less technologically complex processes like large batch or mass production, work was more likely to be coordinated through centralized authority, increased managerial span of control, and greater formalization and standardization of work activities. In contrast, organizations using more technologically complex processes like customized or small batch production were more likely to coordinate work activities using decentralized authority, reduced span of managerial control, and greater flexibility in deciding how tasks should be completed. Based on these findings, Woodward rejected the assumption of a universally best approach to organizational structure, arguing instead that technology played a determining role in the way work is structured in organizations.

Technology has been studied at both the organizational and subsystem levels. Early SCT researchers focused on the relationship between technology and structure at the organizational level. In general, studies at this level suggested that organizational size rather than technology is the primary determinant of structure. Technology was defined in these studies, however, as the transformation techniques that were typical of the entire organization. This approach has been criticized because it assumes that the technology in an organization does not vary across subsystems. Arguing that technology should be focused on the work itself and the behaviors and decisions that are required to complete the work, organizational researchers recommended that

Table 2

Summary of Concepts Used as Manifestations of the Internal Environment

Concepts	**Definitions**
Input Uncertainty	Number of choices or alternatives in a given situation or the probability of various alternatives occurring (Argote, 1982)
Culture	A pattern of assumptions held by a workgroup that influences their ability to adapt to and integrate new technologies (Ifinedo, 2007)
Environmental Complexity	Number and heterogeneity of groups, subunits, or departments that interact with the focal unit (Leatt & Schneck, 1982)
Environmental Pervasiveness	Frequency of contact with groups, subunits or departments outside the focal unit (Leatt & Schneck, 1982)

Table 3

Summary of Concepts Used as Manifestations of External or Internal Environment

Concept	**Definitions**
	Environmental Complexity
Environmental Complexity	Degree of sophisticated knowledge needed to operate in the environment (Mintzberg, 1979)
	Comprehensibility of the work or degree of sophisticated knowledge needed to do the work and manage the diversity of inputs and other environmental elements (Sharfman & Dean, 1991)
	Heterogeneity of activities that are relevant to an organization's operations (Jurkovich, 1974; Child, 1972a)
	Number of interacting relationships that are relevant for decision making (Duncan, 1972b)
	Amount of knowledge needed to understand elements in the environment (Hunter, 2002)
	Number and diversity of factors that must be contended with in decision-making (Tung, 1979)
	Level of complex knowledge required to understand the environment (Sharfman & Dean, 1991)
Decision-Making Uncertainty	Insufficient information about cause-effect relationships and inability to predict outcomes (Leblebici & Salancik, 1981)
	Extent to which decisions are guided by definitive procedures and the development of relatively fixed responses (Duncan, 1973)
	Number of and degree of familiarity with factors that must be considered in decision-making (Duncan, 1972a)
Information Specificity	Extent that information is specific to a given situation (Huber, O'Connell, & Cummings, 1975)

Table 3 (continued)

Concept	Definitions
Environmental Uncertainty	Degree of accuracy with which one can predict the future (Tosi, Aldag, & Storey, 1973)
	Inability to forecast future events based on the information at hand (Anderson & Tushman, 2001)
	Lack of information clarity, degree that a cause-effect relationship is unknown, and length of time required for feedback about results (Lawrence & Lorsch, 1967)
	Lack of information about environmental factors that affect a decision, lack of knowledge about outcomes of a decision, and inability to assign probabilities to the effect of environmental factors on performance (Duncan, 1972a)
	Directed behavior based on less than complete knowledge (Downey & Slocum, 1975)
Environmental Variability	
Environmental Variability	Frequency of change in relevant activities, degree of difference in each change, and degree of irregularity in the overall pattern of change (Child, 1972a; 1972b)
	Location of environmental change on a continuum from placid to turbulent (Emery & Trist, 1965)
	Changes in environmental conditions that are difficult to predict (Child, 1974)
	Degree of environmental change ranging from static to dynamic (Tushman, 1979)
Environmental Change Rate	Number of major goal alterations during a given period (Jurkovich, 1974)
	Rate of technical change (Burns & Stalker, 1966)
	Frequency and magnitude of turbulence among environmental factors (Tung, 1979)

Table 3 (continued)

Concept	**Definitions**
Environmental Change Stability	Predictability of change in the internal and external environments (Tung, 1979)
	Inter-organizational Interactions
Environmental Dependency	Degree to which a system relies on specific elements in the environment for growth and survival and how interdependent these elements are (Osborn & Hunt, 1974)
	Environmental Favorableness
Resource Availability	Level of resources available from the environment (Sharfman & Dean, 1991; Pfeffer & Salancik, 1978, Yuchtman & Seashore, 1967)

technology, especially among large and complex organizations, should be studied at the subsystem level where the work is done (Child, 1972a; Comstock & Scott, 1977; Rousseau, 1983; Rousseau & Cooke, 1984).

Since Woodward's study, numerous concepts related to technology at the organizational level have been studied. In a summary of 37 technology-structure studies, Fry and Slocum (1984) grouped these concepts into five dimensions: technological complexity, operations technology and variability, technological interdependence, technological routineness, and manageability of raw materials. Similarly, others described technology in terms of three major types: operations technology, material technology, and knowledge technology (Hickson, Pugh, & Pheysey, 1968; Perrow, 1967, 1970; Woodward, 1965). Operations technology refers to the techniques that are used to equip and sequence workflow activities. Material technology refers to characteristics of the object that is the focus of the transformation process and the physical and informational resources that are required during the transformation process. Finally, knowledge technology addresses work exceptions that are encountered when completing tasks and the extent to which these exceptions can be analyzed and resolved.

Other researchers defined technology at the subsystem level using work- or task-related characteristics although some have used these characteristics as part of their definition of the environment (Leatt & Schneck, 1982; 1984; Moon et al., 2004). In general, studies using task-related concepts as manifestations of technology focus on three characteristics: task predictability, task interdependence, and task analyzability (Rousseau, 1983; Rousseau & Cooke, 1984). Task predictability can be defined as the extent to which tasks are routine and programmable and, therefore, can be standardized (Comstock & Scott, 1977; Ford &

Slocum, 1977; Hrebeniak, 1974; Perrow, 1967). Thompson (1967) identified task interdependence as a manifestation of technology. He described three types of interdependence: pooled, sequential, and reciprocal. Pooled interdependence refers to tasks that can be performed under conditions of minimal interdependence, meaning that employees work independently to complete task assignments. Sequential interdependence refers to tasks that require multiple workers to complete. Although each worker can complete their portion of the task in a linear fashion, task completion depends on work that has been previously completed by other workers. Finally, reciprocal interdependence describes an input-output transformation process in which the object of the work is not only passed back and forth among workers who bring different knowledge and expertise to the transformation process but also depends on reciprocal feedback among those who contribute to task completion. Finally, task analyzability refers to work exceptions that are encountered during task completion and the extent to which exceptions can be analyzed using search behaviors and logical analysis to identify solutions (Perrow, 1967). A summary of concepts used as manifestations of technology at the organizational and subsystem levels along with their definitions is provided in Table 4.

Organizational Structure

Numerous definitions of structure are found in the SCT literature. Structure has been defined as the arrangement of people for getting work done and “the extent to which individuals interact with one another” (Perrow, 1967, p.195), the “arrangement of people, subsystems and departments in the organization” (Fry, 1982, p. 539), the “formal allocation of work roles and the administrative mechanisms that are used to control and integrate work activities” (Child, 1972b, p.2), and the way “large numbers of persons are differentiated into smaller groups as well as how the independent actions of these differentiated groups are coordinated" (Hollenbeck, 2002, p. 600).

Concepts used as manifestations of organization structure are listed in Table 5. Although multiple concepts have been studied, several are consistently recognized as core dimensions of structure: centralization, formalization, standardization, specialization, and differentiation. Centralization refers to the extent to which decision-making authority is located at or near the top of the organizational hierarchy or is dispersed among organization members. Formalization refers to the extent to which job descriptions and requirements are in writing. Specialization refers to the number of specialized roles in the organization. Differentiation refers to segmentation of the organization into subsystems where designated portions of the input-output process are completed.

Organizational Effectiveness

The literature on organizational effectiveness abounds with multiple perspectives. In fact, several researchers argue that there is no single definition of effectiveness that can be applied to all organizations (Dikmen, Birgonul, & Kiziltas, 2005; Hitt, 1988; Tosi & Slocum 1984; Tsui, 1990). However, Yuchtman and Seashore (1967) suggested that organizational effectiveness can be explained using a system resource approach. This approach focuses on how an organization acquires needed resources and engages in the transformation process, which includes the ability to exploit the environment to generate desired performance within the parameters of effectiveness, efficiency, relevance, and financial viability. Another approach to the explanation of organizational effectiveness is the goal attainment model (Herman & Renz, 2004). According to this model, effectiveness is the degree to which an organization achieves the goals and outcomes that are consistent with its mission. All health

Table 4

Summary of Concepts Used as Manifestations of Technology

Concepts	**Definitions**
	Technology in General
Technological Complexity	Extent that technology is complex based on the use of custom or small unit, large batch or mass and continuous production processes (Blau, Falbe, McKinley, & Tracy, 1976; Ellis, Almor, & Shenkar,2002; Mohr, 1971; Reimann, 1977; Woodward, 1965)
	Number of factors that must be considered in decision-making, goal setting, and goal attainment (LaPorte, 1971)
Technological Determinacy	Extent that the technology is characterized by the availability of cause-effect relationships to guide work completion (Mansfield, 1974)
	Extent to which tasks are uncertain, variable, and unstable (Overten, Schneck, & Hazelett, 1977)
Technological Variety	Degree to which work exceptions cannot be analyzed using search behaviors (Overten, Schneck, & Hazelett, 1977)
	Extent that workers possess the information needed about the technology (Teasley & Robinson, 2005)
Technology Unpredictability	Degree to which raw materials and transformation processes are well understood so they present few unexpected exceptions for a qualified worker (Comstock & Scott, 1977)
Technology Equivocality	Degree that a technology is ambiguous (Daft & McIntosh, 1981; Teasley & Robinson, 2005)

Table 4 (continued)

Concepts	Definitions
System Embeddedness	Extent that knowledge of the transformation process is site-specific, meaning that it depends on the system or context in which it is embedded (Birkinshaw, Nobel, & Ridderstrale, 2002)
Technology Interdependence	Extent that action taken on one unit affect actions and work outcomes on another unit (Morton & Hu, 2008)
Technology Sophistication	Extent that inputs, throughputs, and outputs are standardized or variable (Taylor, 1971)
Technical Change Rate	Relative rate of innovation in work-related technologies (Reimann, 1977)
	Rate of technical change ranging from rapid to slow (Burns & Stalker, 1961; Mansfield, 1973; Pfeffer & Leblebici, 1973)
	Extent that the organization must absorb and master technical change (Anderson & Tushman, 2001)
Technology Related to Operations and Production	
Operations Technology	Degree to which a manufacturer emphasizes custom, small batch, large batch, mass or continuous production processes (Reimann, 1977)
Operating Variability	Extent that workflow activities are automated, completed using devices with self-acting capability, completed using rigid production steps, or completed using technologies that permit throughput continuity (Hickson et al., 1969; Pugh et al., 1969)
Operational Smoothness	Dominant method or style of production ranging from single unit, small batch, large batch, mass or continuous flow production (Starbuck, 1965)

Table 4 (continued)

Concepts	**Definitions**
Operating Techniques	Degree to which tasks involve staff-client relationships and interactions and the extent that search behaviors require technical, judgment, or communication skills (Overton, Schneck, & Hazelett, 1977)
Program Specification	Extent that organizational communication and interaction patterns are predetermined and predictable (Harvey, 1968)
Product Mix	Extent to which product or service demand is sufficient to permit systemization of work activities (Van de Ven & Delbecq, 1974)
Production Specificity	Number of major changes in products, product design, tooling, and materials over a specified period of time (Harvey, 1968)
Production Continuity	Classification of the work as single unit, batch, mass or continuous flow production (Hickson et al., 1969; Child & Mansfield, 1972; Reimann, 1977)
Throughput Continuity	Extent that the throughput process is continuous or periodic (Hunt, 1970)
	Technology Related to Workflow
Workflow Predictability	Extent to which raw materials and transformation processes are well understood and non-problematic for the workgroup (Comstock & Scott, 1977)
Workflow Dependence	Dependence on a parent organization or trade union to complete work activities (Aldrich, 1972)
	Relationship of the organization with suppliers and customers (Inkson, Pugh, Hickson, 1970)
Workflow Uncertainty	Daily fluctuations and variations over time in workflow (Schoonhoven, 1981)

Table 4 (continued)

Concepts	Definitions
Workflow Integration	Degree of automation of work, extent that breakdowns and delays have an immediate effect on production, interdependence of workflow segments and extent that measurement is used to evaluate outputs (Child & Mansfield, 1972; Hickson et al., 1969; Pugh et al., 1969; Reimann, 1977)
	Degree of automated, continuous, or fixed sequence operations in the technology (Hickson et al., 1969; Inkson et al., 1970)
Technology Related to Tasks	
Task Characteristics	Degree of task predictability or routineness and, thus, the amount of uncertainty that must be dealt with (Tushman, 1979)
Task Manageability	Extent that tasks are uniform or not, complex or not, and analyzable or not (Hrebiniak, 1974; Mohr, 1971)
Task Variability	Number of exceptional cases encountered in the work requiring different methods or procedures for doing the work (Van de Ven & Delbecq, 1974)
	Stability or uniformity of inputs and outputs (Hickson et al., 1968; Thompson, 1967)
	Routineness, repetitiveness, stability, or rigidity of work processes (Delbecq, Shull, Filley & Grimes 1969; Grimes & Klein, 1973; Hage & Aiken, 1969; Litwak, 1961)
	Degree to which workers must engage in multiple tasks (Alexander & Randolph, 1985; Overton et al., 1977)

Table 4 (continued)

Concepts	Definitions
	Diversity of inputs (Rousseau, 1983)
	Extent that the transformation of raw materials can be standardized or continual adjustment is needed (Perrow, 1967)
	Degree of unpredictable fluctuations in work techniques and practices (Alexander & Randolph, 1985; Overton et al., 1977)
	Degree of instability in the tasks to be performed or the frequency with which work exceptions must be addressed (Leatt & Schneck, 1981; 1982; Overton et al, 1977)
	Degree of unpredictable fluctuations in operating techniques (Leatt & Schneck, 1981)
Task Routineness	Extent that work problems are familiar and can be managed with limited uncertainty or are unfamiliar and increase information needs of the organization (Duncan, 1972a; Jurkovich, 1974; March & Simon, 1958; Perrow, 1970)
	Variability and analyzability of the stimuli confronting the organization (Tung, 1979)
	Programmability of work-related decisions (Simon, 1960)
	Number of work exceptions and the extent that search behaviors are used to solve them (Hage & Aiken, 1969; Perrow, 1967)
	Amount of job variety, extent that job descriptions and procedures are well-defined, and extent that rules are enforced (Hage & Aiken, 1969)
	Extent that work is repetitive and predictable (Glick, Wang & Huber, 1991; Hrebiniak, 1974; Keller, 1994; Miller, Withey et al., 1983; Van de Ven et al., 1976)

Table 4 (continued)

Concepts	**Definitions**
	Difficulty in analyzing tasks in terms of alternative courses of action, cost, benefits, and outcomes (Daft & Macintosh, 1981)
Task Interdependence	Extent that work activities require checking or working with others (Hrebiniak, 1974)
	Extent that the completion of one or more discrete operation has consequences for the completion of others (Fry & Slocum, 1984)
	Degree that activities in an organization are connected to each other (Morton & Hu, 2008)
	Extent to which task completion requires coordinated effort of multiple workers, exchange of information, and feedback (Stoelwinder & Charns, 1981)
	The need for coordinated action among multiple organizational elements to complete the work (Randolph, 1981; Thompson, 1967)
	Extent that intra-unit and inter-unit coordination, communication, joint problem-solving, and decision-making are required to complete the work (Tushman, 1979)
	Degree that one relies on co-workers to complete assignments (Overton et al., 1977)
Task Analyzability	Amount of search behavior needed to deal with exceptions encountered during work performance (Randolph, 1981)
	Existence of analytical procedures to solve task-related problems (Keller, 1994)
	Extent that the technology in an organization is ambiguous (Teasley & Robinson, 2005)
	Availability of concrete information about task activities and the degree to which required search process in the event of exceptions is complex (Chang, Chang, &Paper, 2003)

Table 4 (continued)

Concepts	Definitions
Task Uncertainty	Degree that the task is difficult to understand and complex (Alexander & Randolph, 1985; Overton et al., 1977)
	Difference between the information needed to complete a task and the amount of information present (Morton & Hu, 2008)
	Ambiguity resulting from task characteristics, task environment, and task interdependence (Tushman, 1979)
	Amount of knowledge that workers must bring to the transformation process (Rousseau, 1983)
	Degree that raw materials are not well understood (Overton et al., 1977)
	Degree to which there is insufficient knowledge about raw materials and the probability of achieving intended outcomes (Leatt & Schneck, 1981; 1982)
Task Predictability	Extent that the work is routine, uniform, and programmable (Ford & Slocum; 1977; Hrebiniak, 1974)
	Extent that raw materials and transformation processes are well understood and non-problematic for workers (Comstock & Scott, 1977)
	Number of unexpected exceptions or problems encountered in performing a task (Randolph, 1981)
Task Difficulty	Extent that work is analyzable and there is a known procedure specifying the sequence of steps to be followed in completing tasks (Van de Ven & Delbecq, 1974)
	Degree of complexity in the search process needed to perform the work, amount of thinking required to solve problems, and the knowledge needed to perform tasks (Perrow, 1967)

Table 4 (continued)

Concepts	Definitions
Task Complexity	Degree of routineness or unpredictability in tasks leading to increased uncertainty (Tushman, 1979)
	Degree that factors relevant to task performance are few or many in number and are similar or dissimilar (Duncan, 1972a)
Task Manageability	Extent to which tasks are complex or simple, variable or stable, or well or poorly understood (Hrebiniak, 1974; Mohr, 1971)
Knowledge Observability	Degree to which it is easy to understand the task by examining aspects of the production process or the final product (Birkinshaw et al., 2002)
Task Scope	Variety of inputs or task that need to be accomplished (Dewar & Hage, 1978)
Task Uniformity	Extent that tasks are simple, few work exceptions are encountered, and task completion requires minimal training (Litwak, 1961)

Table 5

Summary of Concepts Used as Manifestations of Structure

Concepts	**Definitions**
	Structure in General
Complexity	Extent of horizontal, vertical, spatial, and personal differentiation (Ford & Slocum, 1977)
	Number of different occupational specialties (Dalton, Todor, Spendolini, Fielding, & Porter, 1980)
	Extent of formalization, decentralization, and task specialization (Martin, Osborn, Benandi, & Hunt, 1980)
	Number of occupational specialties, degree of professional training, and amount of professional activity among unit staff (Leatt & Schneck, 1982)
Structuring of Activities	Extent that work activities are standardized, specialized, and formalized (Pugh et al., 1969)
	Degree of formal regulation of the intended activities of employees (Hickson et al., 1969; Inkson et al., 1970)
Frequency of Change	Frequency of changes to policies and programs (Tung, 1979)
Time Perspective in Planning	Extent to which structural planning focuses on short-term or long-term goals (Tung, 1979)
Work Integration	Process of achieving unity of effort among subsystems to accomplish organizational tasks (Lawrence & Lorsch, 1967)
Inter-Unit Integration	Extent to which goal attainment depends on collaboration among similar units (Birkinshaw et al., 2002)

Table 5 (continued)

Core Components of Structure	
Concepts	**Definitions**
Centralization	Locus of decision authority (Child & Mansfield, 1972; Dalton et al., 1980; Pugh et al., 1968)
	Ability of staff to influence organizational decisions (Comstock & Scott, 1977)
	Locus of formal control or power in the organization, including autonomy, participation in decision-making, and hierarchy of authority (Ford & Slocum, 1977)
	Percentage of decisions that the chief officer delegates to subordinates, locus of decision-making authority, degree of information sharing across levels, and participation in long-range planning (Reimann, 1977)
	Extent that coordination is achieved through informal contact with peers or mediated by a supervisor (Tushman, 1979)
	Extent that power over decision-making is dispersed among members (Mintzberg, 1980)
	Extent of influence regarding task-relevant decisions (Schoonhoven, 1981)
	Degree of participation in work-related decisions (Leatt & Schneck, 1982)
	Distribution of authority in the organization (Fry & Slocum, 1984)
	Extent that decision-making authority is retained at or near the top of the hierarchy (Miller et al., 1991)
	Extent that decisions are made by managers or those closest to the action (Chang et al., 2003)

Table 5 (continued)

Concepts	Definitions
Concentration of Authority	Extent that the organization is characterized by centralized or autonomous decision-making (Pugh et al., 1969)
	Degree to which authority to make decisions is centralized at higher hierarchical levels (Hickson et al., 1969)
	Level at which formal authority rests (Inkson et al., 1970)
Formalization	Extent that paperwork is used to execute procedures and govern role performance (Child & Mansfield, 1972; Pugh et al., 1969)
	Reliance on rules and other formalized procedures as a means of control and coordination (Comstock & Scott, 1977)
	Degree to which rules and procedures are specified and adhered to (Ford & Slocum, 1977)
	Extent that rules, procedures, and instructions exist and are used (Reimann, 1977)
	Extent that rules are written down (Tung, 1979)
	Extent that appropriate behavior is described in written job descriptions (Dalton et al., 1980)
	Degree that role definitions and role specifications are defined through written rules and regulations (Leatt & Schneck, 1982)
	Degree of job codification and rule observance (Fry & Slocum, 1984)
	Extent that well specified rules and procedures are used to guide behavior (Miller et al., 1991)
	Standardization and documentation of work processes (Donaldson, 2001)
	Degree to which rules and procedures are documented and known to all employees (Ifinedo, 2007)

Table 5 (continued)

Concepts	**Definitions**
Rule Usage	Extent that work activities are determined by rules and procedures and adherence is required (Hrebiniak, 1974)
Standardization	Number of rules and procedures in the organization (Child & Mansfield, 1972; Pugh et al., 1969)
	Extent that policies and procedures govern work activities (Comstock & Scott, 1977)
	Extent that operations are subject to rules (Tung, 1979)
	Extent that behaviors and procedures for work completion are spelled out (Dalton et al., 1980)
	Extent to which documented and unwritten but understood rules exist (Schoonhoven, 1981)
Differentiation	Segmentation of the organization into subsystems, each with attributes related to the work requirements posed by the external environment (Lawrence & Lorsch, 1967)
	Number of job categories and people in those categories at the unit level (Comstock & Scott, 1977)
	Differences in goal orientation and formality of the structures of organizational units (Donaldson, 2001)
Specialization	Number of functional specialties and professional requirements (Reimann, 1977)
	Number of different occupations or functional activities (Dalton et al., 1980)
	Number of occupational specialties (Fry & Slocum, 1984)
	Extent that tasks are divided into narrow domains (Miller et al., 1991)
	Extent that tasks are subdivided into separate jobs (Ifinedo, 2007)

Table 5 (continued)

Concepts	Definitions
Professional Specialization	Level of professional training and involvement in professional activities among unit staff (Schoonhoven, 1981)
	Percentage of units staffed by professionals whose roles require years of formal training (Miller et al., 1991)
Functional Specialization	Number of functional roles that are performed by specialists (Child & Mansfield, 1972; Pugh et al., 1968)
Role Specialization	Extent that various roles are performed by specialists (Child & Mansfield, 1972; Pugh et al., 1968)
	Structural Configuration
Configuration	Shape of the organization in terms of vertical span and subordinate ratio (Child & Mansfield, 1972; Pugh et al., 1968)
Administrative Intensity	Proportion of the total organization targeted to administrative functions (Caplow, 1957)
	Relative size of the administrative component (Anderson & Warkov, 1961; Raphael, 1967;Terrien & Mills, 1955)
	Number of administrative personnel divided by the number of production workers (Dalton et al., 1980)
Departmentalization	Division of labor into work units based on functional similarity or geographic or product market differences (Hollenbeck et al., 2002)
Structural Support	Percentage of non-workflow personnel like clerks and auxiliary staff (Pugh et al., 1968)

Table 5 (continued)

Structural Coordination	
Concepts	**Definitions**
Coordination	Planned or programmed interaction of tasks and feedback or negotiated alterations in the sequence of tasks performed (Perrow, 1967) Fitting together the activities of organizational members (Argote, 1982) Linking together different parts of an organization to accomplish a collective set of tasks (Nidumolu, 1996)
Programmed/Nonprogrammed Coordination	Extent that work activities are coordinated using rules, pre-specified procedures, and decision-making by authority entities or by on-the-spot mutual adjustment, information sharing, problem-solving, and decision-making (Argote, 1982)
Horizontal/Vertical Coordination	Extent that work is coordinated horizontally through mutual adjustment and communication or vertically through decisions by authorized entities (Nidumolu, 1996) Decision-making hierarchy in the organization (Ifinedo, 2007)
Horizontal/Vertical Participation	Degree that individuals are involved with peers in decision-making and defining tasks or consult with supervisors about job-related tasks and decisions (Alexander & Randolph, 1985)
Structure Related to Administrative Control	
Control	Amount of discretion individuals or groups have to carry out their tasks and the power to mobilize scarce resources or control raw materials (Perrow, 1967)

Table 5 (continued)

Concepts	**Definitions**
Performance Programs	Division of labor into one of three categories according to performance-related expectations: systematized, discretionary, and developmental (Van de Ven & Delbecq, 1974)
Unitary/Fragmented Control	Existence of a single integrated control system or multiple control systems that organizational members must satisfy (Hrebiniak, 1974; Reeves & Woodward, 1970)
Personal/Mechanistic Control	Extent to which goal attainment and division of workflow depend on an individual's authority over others or is regulated by impersonal administrative means (Hrebiniak, 1974; Reeves & Woodward, 1970)
Impersonality	Extent that decisions are made using rules and procedures or an informal network of relationships (Duncan, 1973; Leifer & Huber, 1977)
Line Control of Workflow	Extent that workflow control rests with line personnel and supervisors (Pugh et al., 1968)
	Control of throughput operations by line management rather than impersonal control using rules and procedures (Hickson et al., 1969)
Autonomy	Freedom to decide how to complete tasks, achieve work goals, adopt approaches to work, and make work-related decisions (Hrebiniak, 1974)
	Degree of independence in unit-level decision-making (Leatt & Schneck, 1982)
	Extent that the work unit can make strategic decisions without the involvement of corporate headquarters (Birkinshaw et al., 2002)
Decision-Making Participation	Extent of employees participation in unit- and job-related decisions

Table 5 (continued)

Structure Related to Supervision	
Concepts	**Definitions**
Supervision	Supervisors' perception of their role independence, number of decisions in which they can participate, and leadership style (Hrebiniak, 1974)
Closeness of Supervision	Frequency of close observation by a supervisor of employees' work and percentage of work activities that are determined by a supervisor (Hrebiniak, 1974)
Span of Control	Number of subordinates who report directly to a supervisor (Dalton et al., 1980)
Structure Related to Information Processing	
Problem-Solving Expertise	Amount of expertise required for problem-solving and decision-making as task difficulty increases (Van de Ven & Delbecq, 1974)
Staff Qualifications	Average qualifications of staff (Comstock & Scott, 1977)
Information Amount	Quantity of information available through a network of relevant sources (Teasley & Robinson, 2005)
Information Richness	Extent to which available information enhances understanding of tasks and technology (Teasley & Robinson, 2005)

care organizations share common goals that include providing care that is safe, effective, patient-centered, timely, efficient, and equitable (Institute of Medicine, 2001). For this reason, the goal attainment model will be used in this study to conceptualize organizational effectiveness. High quality care will be defined as fewer medication errors and efficient care will be defined as shorter lengths of hospital stay.

Uncertainty and Information Processing

Two concepts, in particular, have been used by organizational theorists to explain how context, structure, and effectiveness are interconnected: uncertainty and information processing. Galbraith (1972) used uncertainty and the need for information to reduce uncertainty as a way to explain how context, structure, and effectiveness are connected. According to Galbraith (1972), uncertainty results from differences in the amount of information needed to complete a task and the amount of information already possessed. He argued that organizational environment and technology are sources of uncertainty that increase the information needs of an organization. In general, environmental uncertainty has been defined in terms of attributes of the environment like variability (stable or unstable), change frequency (frequent or infrequent), change stability (predictable or unpredictable), rate of change (rapid or incremental), and complexity (routine or dynamic) (Lawrence & Lorsch, 1967; Thompson, 1967; Wholey & Brittain, 1989). Child (1972), in particular, identified environmental variability as a source of uncertainty in organizations, especially when it results from frequent changes in the environment and unanticipated variability in the pattern of change. Other SCT researchers have focused on the task component of technology as a source of uncertainty. Lawrence and Lorsch (1967) described task uncertainty as the amount of ambiguity and unpredictability that is encountered in the input-output cycle through which goods or services are designed, produced, and distributed. Galbraith (1972) proposed two dimensions of task uncertainty that increase the information needs of an organization: task variability and task analyzability. He argued that these dimensions increase the amount of information needed to resolve work exceptions.

Structure can be seen as the administrative approaches that are used by organizations to coordinate information processing (Daft & Lengel, 1986; Galbraith, 1972; Huber, 1982). Because different types of structure differ in their ability to meet the information needs of an organization, Galbraith recommended that structure should be aligned with the level of uncertainty in the organization. He identified two approaches that can be used to address information needs under conditions of uncertainty. First, he suggested that work could be structured to reduce information needs. Second, he suggested that work could be structured to increase the capacity of the organization to process information.

Six hierarchical strategies were identified by Galbraith (1972) to reduce information needs. First, work standardization through rules and protocols can reduce information needs by specifying in advance the work behaviors that are appropriate in a specific job-related situation. This approach, however, becomes less useful as task uncertainty increases. Second, reliance on hierarchical decision-making reduces information needs because decisions are made only by a limited number of people in the organization. Third, planning is a strategy in which goals are established for workers who then select the most appropriate methods to achieve those goals. Planning shifts decisional authority to lower levels in the organizational hierarchy which reduces information processing demands for those in higher level positions. Fourth, organizations can use slack resources to reduce the amount of time-sensitive information that is needed. Slack resources can be used, for example, to alter work deadlines or reassign work tasks to other departments so that information needs do not exceed information processing capacity. Along with planning, slack sources reduce the interdependence between organizational subsystems and, therefore, the amount of information that is needed to coordinate work activities. Finally, structured self-containment in which autonomous departments are created can be used to reduce information needs because it reduces the number of people in the organization who must be included in the communication and coordination process.

Galbraith (1972) also identified two strategies to increase information processing capacity in organizations. First, the vertical flow of information can be improved to insure that accurate information is always available. Specifically, information processing capacity can be increased by adding clerical or other planning staff who can update information on a regular basis. Second, information processing capacity can be increased by horizontally expanding organizational structure to increase lateral relationships in terms of the number of people, groups, teams, and subsystems that are responsible for processing information. Lateral relationships can be increased, for example, by creating liaison roles, coordination roles, problem-solving task forces, and teams. Finally, although not identified by Galbraith, computerized information technology can be used to increase information processing capacity in organizations.

Contextual-Structural Fit

The match or fit among context and structure is a central component of SCT. In fact, SCT suggests that the relationship between structure and effectiveness depends on the contextual attributes of the organization. In other words, SCT theorists argue that variance in organizational effectiveness can be attributed not only to the singular effects of contextual and structural variables but also the fit among contextual and structural variables. Early efforts to test contingency theory focused almost exclusively on describing relationships among contextual and structural variables, based on the assumption that evidence of relationships consistent with theoretical predictions was indicative of fit. In the 1980s, however, emphasis shifted from defining fit in terms of relationships among context and structure to evaluating contextual-structural fit as a necessary but not sufficient indicator of organizational effectiveness (Donaldson, 1987; Drazin & Van de Ven, 1985; Fry & Smith, 1987; Schoonhoven, 1981).

The definition of fit remains ambiguous. Further various terms have been used by SCT researchers to define fit, including, for example, matched, contingent, consistent, congruent, and coaligned (Meilich, 2006). Similarly, fit has been measured as a categorical (fit or no fit) and as a continuous variable (poor to good fit) (Ellis et al., 2002). Additionally, there is no single agreed upon approach to the evaluation of fit although several approaches have been identified.

Both reductionist and holistic approaches to the evaluation of fit are described in the organizational literature (Bergeron, Raymond, & Rivard, 2001; Meilich, 2006; Teasley & Robinson, 2005; Venkatramen, 1989). Specifically, reductionist approaches emphasize three variable relationships in which the association between a single structural and a single effectiveness variable is dependent on or moderated by a single contextual variable. When using this approach, fit is examined using a selection, congruence, interaction or moderation, or deviation model.

The selection model does not define fit in terms of an effectiveness criterion but, rather, focuses on the correlation between context and structure or the extent to which the contextual variable predicts the structural variable. This approach to the evaluation of fit is characteristic of much of the early work to test SCT in which effectiveness was assumed to exist when hypothesized relationships among contextual and structural variables were documented (Drazin & Van de Ven, 1985). For example, Fry (1982) tested the correlation between technology uncertainty and specific structural forms and found that technology uncertainty was negatively correlated with formalization.

In the congruence model, effectiveness is defined as organizational survival and fit is seen as part of the evolutionary process through which organizations remain viable. Three forms of congruence can be evaluated using this model: effect, general, and functional congruence (Alexander & Randolph, 1985; Drazin & Van de Ven, 1985; Fry & Slocum, 1984; Joyce, Slocum & Von Glinow, 1982; Tosi & Slocum, 1984). Effect congruence focuses on the relative importance of contextual and structural variables in explaining the variance in effectiveness, based on the assumption that explained variance in effectiveness increases as the fit between contextual and structural variables increases. General congruence suggests that effectiveness is explained by the extent to which values of the contextual and structural variables are comparable, meaning that scores for both are either low or high. Finally, functional congruence suggests that variance in effectiveness is explained by either the contextual or structural variable but not by their joint occurrence.

In the interaction or moderation approach, fit is evaluated by examining the relationship between contextual and structural variables under different conditions of a contextual variable. In this model, the contextual variable is treated as a moderator of the relationship between structure and effectiveness. Schoonhoven (1981) identified two major types of interaction: multiplicative and maximizing. Multiplicative interactions are shown when the relationship between structure and effectiveness increases as the value of the contextual variable increases. Maximizing interactions are defined as the extent to which effectiveness is maximized when a given value of a structural variable corresponds with a given value of the contextual variable.

Finally, in the deviation model, fit is defined as the extent to which contextual and structural variables are ideally matched. In other word, this method created a standard score for context and structure and tested the relationship between this score and effectiveness. Organizations are thought to be less effective as their context and structure deviate from this ideal.

In recent years, many SCT theorists have argued for a more holistic approach to the evaluation of fit in which relationships among different combinations of multiple contextual and structural variables and effectiveness are investigated. Multivariate approaches to the assessment of fit include the covariation, profile deviation, and gestalt or systems models (Bergeron et al., 2001). In the covariation model, fit is defined as the extent to which variability in contextual and structural variables can be explained by an overarching latent factor that represents context. In the profile deviation model, a multivariate set of variables is used to identify an ideal profile of an effective organization or subsystem. Effectiveness is thought to decline among organizations or subsystems that deviate from this ideal profile. Finally, in the gestalt or systems model, multiple contingency, structural, and effectiveness variables are evaluated simultaneously. Fit is thought to exist when there is internal consistency among these variable clusters (Drazin & Van de Ven, 1985).

Contextual-Structural Fit and Organizational Effectiveness

Studies of the relationship between contextual-structural fit and effectiveness have resulted in mixed findings. The most frequently studied contextual variables, those upon which the relationship between structure and effectiveness is contingent, are organizational size, task analyzability, task uncertainty and task routineness. Although Penning (1975) and Ifinedo (2007) found that contextual-structural fit was not associated with organizational performance when *organizational size* was used as the contextual variable, others researchers have reported opposite findings (Coulter, 1979; Khandwalla, 1973; Stopford & Wells, 1972). Stopford & Wells found that contextual-structural fit was associated with better performance when formalization was used as the contextual variable. In other words, greater use of formalization among large organizations was associated with better performance. Studies to investigate the relationship between contextual-structural fit and organizational performance when *task analyzability* was specified as the contextual variable have resulted in mixed findings. Tushman (1979) found that fit between task analyzability (context) and the use of vertical or horizontal communication (structure) was not associated with effectiveness. Keller (1994) documented similar findings in a study of fit between task analyzability (context) and information processing capacity (structure) with organizational performance. On the other hand, Fry and Slocum (1984) found that, under conditions of high task analyzability (context), greater specialization (structure) improved workgroup performance (effectiveness).

Three studies were found in which *task uncertainty* was used as a moderator of the relationship between structure and effectiveness. Using a bivariate approach to the evaluation of fit, Nidumolu (1996) found that fit between task uncertainty (context) and the use of vertical or horizontal coordination (structure) was not associated with organizational effectiveness. Using the gestalt approach, however, two researchers found strong support for relationships between structure and effectiveness under conditions of high task uncertainty. Drazin & Van de Ven (1985) compared the relationships among three structural forms (systematized, discretionary, and developmental) and effectiveness using task uncertainty as the contextual variable. In this study, a systematized structural form was defined as one in which work roles are well defined, tasks are standardized, and limited discretion is needed to complete work assignments. A discretionary form was defined as one in which workers use their expertise to choose the best method for completing work assignments. Finally, a developmental form was defined as one in which group decision-making, problem-solving, and expert judgment are required to complete work assignments because the focus is on broad goals that can be achieved only through the use of novel or unique methods. Findings from this study indicated that a systematized structural form was most effective when task uncertainty was low; a discretionary structural form was most effective when task uncertainty was medium, and a developmental structural form was most effective when task uncertainty was high. Similarly, Gresov (1989) found that organizations were most effective when standardization, supervisory and employee discretion, workflow independence, and vertical or horizontal communication matched the level of task uncertainty.

Three fit studies using nursing units as the unit of analysis were found in the organizational literature. Using regression analysis to evaluate fit based on the interaction or moderator model, Schoonhoven (1981) investigated the fit among workflow uncertainty as manifestations of context and decentralization, standardization, and professionalization as manifestations of structure in operating rooms. She found that when work flow uncertainty was high, centralization and professionalization were associated with better performance in terms of post-surgical death and complication rates. Although decreased standardization also was associated with better performance, this relationship depended on the level of workflow uncertainty. In other words, when workflow uncertainty reached a specific threshold value, decreased standardization was no longer associated with better performance. Also using the interaction or moderator approach to the evaluation of fit, Argote (1982) studied fit of input uncertainty as a contextual variable and structure with performance among emergency rooms. She found that, under conditions of high input uncertainty, performance was better when a non-programmed approach to work coordination was used. In contrast, when input uncertainty was low, a programmed approach to coordination (for example, rules, scheduled meetings, and authority arrangements) was associated with better performance. Argote concluded that programmed approaches to work coordination make a greater contribution to organizational effectiveness under conditions of low rather than high uncertainty. Finally, Alexander and Randolph (1983) used the general congruence model to evaluate fit using data from 27 nursing units. Specifically, these researchers identified technology instability, variability, and uncertainty as contextual variables and vertical or horizontal communication and formalization as structural variables. Findings from this study suggested that when technology instability was high, increased use of vertical participation in decision-making was not associated with the quality of nursing care. However, when technology variability was high, the use of vertical participation was associated with better quality nursing care. In addition, when technology uncertainty was high, increased formalization was associated with better quality nursing care.

Although multiple approaches to the evaluation of fit have been described in the literature, there is limited agreement about the approach that is most appropriate. For example, Bergeron et al. (2001) suggested that the co-variation and profile deviation approaches are best for theory testing and the gestalt approach is best for theory building. Both Venkatramen (1989) and Donaldson (2001) suggested that evaluation of fit should be guided by theoretical considerations. In particular, Donaldson (2001) suggested that the moderation or interaction approach was most consistent with the premise of SCT that relationships between structure and effectiveness are contingent upon or moderated by contextual variables. Further, most studies in health care organizations have used this approach to test the relationship between contextual-structural fit and effectiveness. Therefore, the moderation or interaction approach was used in this study to test the relationship between contextual-structural fit and effectiveness.

Chapter Summary

In this chapter, SCT as the guiding framework for this study was presented. Context, structure and effectiveness and key SCT concepts were described. Uncertainty and information processing were discussed as summary concepts that connect context, structure, and effectiveness. Fit between context and structure was discussed as the overarching premise of SCT. Different approaches to the definition and evaluation of fit were presented. This chapter concluded with a review of studies conducted to text the relationship between contextual-structural fit and organizational effectiveness. In Chapter 3, a review of the literature addressing the key variables that were tested in this study is presented.

CHAPTER 3

LITERATURE REVIEW

Although work coordination has been a central theme in the organizational literature for many years, the concept of relational coordination is relatively new, first introduced by Gittell in 2000. Chapter III begins with a historical overview of work coordination and its development in the organizational literature. Following this introduction, a review of literature is presented addressing interprofessional collaboration and teamwork as concepts that are broader than but similar to relational coordination. Similarities and differences between these concepts and traditional interpretations of work coordination also will be presented. In addition, studies focused specifically on relational coordination are discussed and compared to traditional work coordination. The major premise of structural contingency theory along with conclusions drawn from the literature review were used to develop hypotheses that were tested in this study. In summary, the goals of this chapter are to review the literature focused on interprofessional collaboration and teamwork, and, more specifically, relational coordination and provide both theoretical and empirical support for the research model and hypotheses that were tested in this study. This research model is diagrammed in Figure 2.

Overview of Work Coordination as an Organizational Concept

Although researchers view coordination as a component of structure, multiple and often diverse dimensions of this concept have been described in the literature. An overview of these dimensions is provided in Table 6. March and Simon (1958) described two central

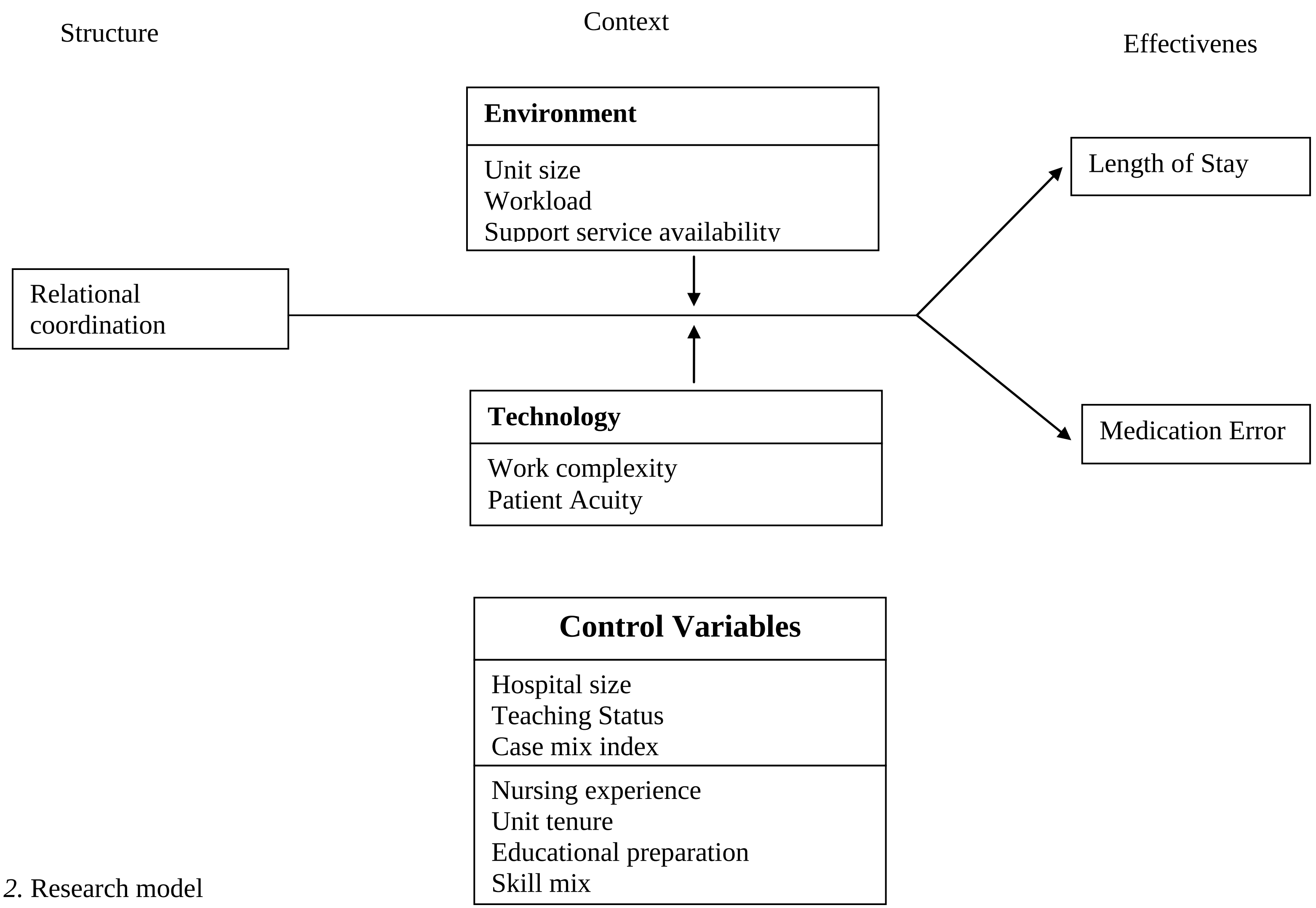

Figure 2. Research model

Table 6.

Similarities among Traditional Coordination, Teamwork, Collaboration, and Relational Coordination

	Traditional Coordination			***Team/teamwork***	***Collaboration***	***Relational Coordination***
Authors	March & Simon (1958)	Van de Ven, et al. (1976)	Mintzberg (1979) Stoelwinder & Charns (1981)	Paris, Salas, & Cannon-Bower. (2000)	D'amour, Ferrada-videla, Rodriguez, & Beaulieu. (2005)	Gittell (2000)
Sub-concepts	**Programming**	**-Coordination:** -Impersonal	**Standardization:** -Work process -Skills -Output			
	Feedback	-Personal -Group	**Mutual Adjustment** **Supervision** **Group Coordination** (Stoelwinder & Charns, 1981only)	**Communication** -Coordination -Adaptability -Interpersonal skills	**Sharing** **-**Goal -Power -Decision-making	**Quality Communication** -Timely -Frequent -Accurate -Problem solving
				Feedback -Performance monitoring **Decision Making** **Stress Management**	**Interdependency** **Partnership**	**Quality Relationships** -Share goals -Mutual respect -Share knowledge

dimensions of work coordination: programming and feedback. These researchers used the term programming to describe the development of written procedures that could be used to ensure consistently uniform task completion. However, March and Simon (1958) also argued that programming becomes less effective as an approach to coordination as the work becomes more complex. According to these researchers, feedback becomes an essential dimension of coordination as work complexity increases. Feedback refers to the interactions among co-workers that are needed to successfully complete work assignments. Although these dimensions of work coordination were identified 50 years ago, researchers continue to investigate work coordination using programming and feedback as identified by March and Simon (Wrobel et al., 2003; Young et al., 1997; Young et al., 1998).

Over the years, the broad concepts of programming and feedback have undergone continued refinement as researchers developed new terminology to describe these concepts and provided greater specificity in their meaning. For example, Van de Ven and Koenig (1976) drew from ideas about programming and feedback to identify three categories of work coordination: impersonal, personal, and group. Impersonal coordination is conceptually similar to programming in that both concepts refer to well defined procedures that describe the best way to complete job tasks. Personal and group coordination are consistent with ideas about feedback because they focus on interactions among co-workers that contribute to task completion (Van de Ven & Delbecq, 1976). Personal coordination refers to one-to-one interactions in which tasks are accomplished through both vertical and horizontal channels of communication. Group coordination focuses on the use of formal and informal interactions as a way to exchange information when more than two persons are involved in completing work assignments. Compared to impersonal and personal coordination, group coordination is most appropriate when work activities are highly interdependent or uncertain. As with programming and feedback, researchers also have investigated coordination using concepts like individual and group communication which are similar to work coordination as described by March and Simon (1958) and Van de Ven and Delbecq (1976) (McGillis Hall, 2003; McGillis Hall & Doran, 2007; McGillis Hall et al., 2003; McGillis Hall, Doran, & Pink, 2004).

Building on the work of Van de Ven and Delbecq (1976), Minzberg (1979) and Stoelwinder and Charns (1981) refined the concepts of programming and feedback as dimensions of coordination. These researchers added greater clarity to programming through standardization by identifying three types of standardization: work, skill, and output. Work standardization refers to completion of work activities using standardized rules, regulations, plans, schedules, and procedures and, for this reason, is similar to programming as described by March and Simon (1958) and Van de Ven and Delbecq (1976). Skill standardization refers to standardization of the training that is needed to perform job tasks. Finally output standardization refers to the extent to which goods or services are consistently produced that meet standardized outcome criteria. Similarly, these researchers also redefined feedback to include mutual adjustment and supervision (Mintzberg, 1979; Stoelwinder & Charns, 1981) as well as group coordination (Stoelwinder & Charns, 1981). Mutual adjustment refers to feedback that occurs through information exchange among individuals who hold comparable positions in the organizational hierarchy (Charns & Schaefer, 1983). In contrast, supervision refers to feedback that occurs through information exchange between workers in supervisory and subordinate roles in the organization. Therefore, mutual adjustment and supervision are comparable to the identification by March and Simon (1958) and Van de Ven and Delbecq

(1976) of vertical and horizontal interactions as approaches to work coordination. Finally, Stoelwinder and Charns (1981) identified group coordination as a specific dimension of feedback, defining it in much the same way as did Van de Ven and Delbecq (1976).

Despite identification of different dimensions of work coordination, all dimensions share a common emphasis on how to achieve effective performance. In particular, these approaches focus primarily on the relationship between the worker and the task, with emphasis on co-worker interactions that are essential for task completion. Therefore, these approaches gave limited attention to the relationships among organizational members and their implications for effective and efficient achievement of organizational goals. In recent years, however, organizational theorists have shifted their thinking to emphasize the importance of workgroups or teams as a factor that contributes to organization performance. As this literature developed, concepts like teamwork, interprofessional collaboration, and relational coordination appeared, each based on the perspective that interpersonal relationships are an important component of work coordination. These three concepts are included in this literature review because they are especially relevant to work coordination in service organizations like hospitals where the work is highly interdependent and requires constant input and reciprocal feedback from multiple health care professionals.

Teamwork

In response to publication of *To Err is Human* (IOM, 1999), teamwork gained renewed emphasis as a factor contributing to effectiveness among health care organizations. In this IOM report, teamwork was recognized as a key factor in reducing human error and promoting health care quality and safety. Based on this report, health care researchers drew from the airline industry and crew resource management literature to examine group interactions and communications and their implications for error prevention and the development of a collective mindfulness about safety in the workplace. In 2004, the IOM published a second report entitled *Keeping Patients Safe: Transforming the Work Environment of Nurses*. This report extended beyond *To Error is Human* by focusing on the need to create, train, and support interdisciplinary teams and collaborative work groups, identify effective team performance criteria, and analyze direct and indirect effects of team performance on health care outcomes (Ingersoll & Schmitt, 2004).

Although these IOM reports addressed the importance of teams in achieving optimal health care outcomes, conceptual ambiguity in the definition of teamwork slowed progress in the development of training strategies that can be used in health care organizations (Ainamo, 2007; Kralewski, Dowd, Heaton, & Kaissi, 2005; Sundstrom, McIntyre, Halfhill, & Richards, 2000). Within the past 5 to 7 years, however, = common teamwork dimensions have been identified as an initial step in the development of training strategies that can be effective in health care organizations. Salas and colleagues, for example, developed a list of five core teamwork dimensions that include team leadership, mutual performance monitoring, backup behavior, adaptability, and team orientation (Paris & Salas, 2000; Salas, DiazGranados, Weaver, & King, 2008; Salas, Sims, & Burke, 2005). *Team leadership* refers to the identification of a designated team leader who is responsible for monitoring team activities in terms of inputs, processes, and outcomes. In particular, the leader plays a central role in motivating the team, developing the skill and knowledge of team members, and creating a positive team atmosphere that promotes high quality relationships. Second, the team leader directs and coordinates the processes that are used to complete work tasks. Finally, the team leader monitors outcomes and obtains feedback to improve and maintain quality team performance. *Mutual performance monitoring* refers to the ability of a team to accurately monitor its own performance through the development of a shared understanding of the team environment and work responsibilities. *Backup behaviors* address the role of team members in supporting effective team performance by anticipating team members' needs and voluntarily shifting task assignments and workloads when needed. Seen as a key characteristic of an effective team, *adaptability* refers to the extent to which a team can flexibly respond to rapidly changing and diverse situations. Adaptability is thought to result from the effective use of backup behaviors and reallocation of resources as needed. Finally, *team orientation* refers to the ability of a team to focus on shared goals while simultaneously incorporating the expertise, preferences, and personal goals of individual members.

Salas et al. (2005, 2008) also identified three interpersonal supporting mechanisms that connect the five dimensions of teamwork: shared mental models, mutual trust, and closed-loop communication. *Shared mental models* can be defined as cognitive structures through which people describe, explain, and predict events in their environment. Team members who share similar mental models are better able to coordinate their actions because they can predict the information and resources that will be needed by other team members. Further, they act based on their understanding of task demands as well as the implications of their own actions for other members of the team (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000)**.** *Mutual trust* is a shared belief among team members that the team will not only achieve its goals but also will protect the interests of individual team members. Mutual trust permits the development of a strong bond among team members which encourages them to help one another. These bonds enhance the ability of the team to rapidly adapt to changing situations. Finally, *closed-loop communication* refers to the approach used to communicate information among effective teams. Unlike open-loop communication where information is indiscriminately shared with all group members, strong teams partition information so it is selectively transmitted to a single team member who assumes responsibility for completing the task and serving as the source for follow-up information. Closed loop communication is especially useful in promoting team performance because it clarifies the individual who is responsible for specific tasks in the input-output process and, thus, reduces the use of indirect communication as the source of needed information. In other words, closed-loop communication insures that each team member knows who is responsible for a specific task and who should be contacted for follow-up information.

The concept of teamwork offers a perspective that differs from traditional work coordination. Teams are defined as two or more individuals who are assigned to different roles and perform interdependent tasks but work together to achieve a common goal (Baker, Day, & Salas, 2006; Baker, Salas, King, Battles, & Barach, 2005). Based on this definition, the teamwork literature places heavy emphasis on the relationships among team members and the role of these relationships in determining how work goals can be effectively and efficiently achieved. Dimensions of teamwork like backup behaviors, team orientation, and mutual performance monitoring are seen as especially relevant to team effectiveness. In contrast, the literature on work coordination originally emphasized programming and feedback as key coordination mechanisms. Although strategies like mutual adjustment, supervision, and group coordination were later added, work coordination focuses primarily on task characteristics as a key factor in determining how work should be structured. Because patient care requires the expertise and skill of multiple health care providers, the teamwork literature offers an enhanced perspective of how work should be structured in health care organizations.

Interprofessional Collaboration

Collaboration has been the focus of extensive research in the organizational literature. In general, collaboration is described as the act of working together as individuals, groups, or organizations to achieve a common goal (Stille, Jerant, Bell, Meltzer, & Elmore, 2005). At the organizational level, both intraorganizational collaboration among work units within the same organization and interorganizational collaboration between two or more independent organizations have been described. Collaboration also has been defined in terms of specific attributes of workgroup members. For example, intraprofessional collaboration is described as a sub-concept of collaboration that focuses on interactions among individuals who are members of a specific professional group. Similarly, interprofessional collaboration refers to interactions among providers who represent different professional groups like nurses, physicians, and pharmacists.

Three key dimensions of collaboration have been identified (D'Amour, Ferrada-Videla, Rodriguez, & Beaulieu, 2005; Sullivan, 1998). The first dimension is described as sharing of goals, power, and decision making, a dimension that is seen as an essential feature of effective collaboration. Goals must be shared so groups can follow the same agenda and work together to complete task assignments. In the absence of goal sharing, individuals are more likely to work in isolation. In addition to goal sharing, power also must be shared so that the efforts of all workgroup members can be used to effectively and efficiently attain shared goals. In fact, collaborative groups that share goals but do not also share power are less likely to be successful. Finally, shared or collaborative decision making is important because it allows the workgroup to make optimal decisions in situations where both tasks and outcomes are uncertain. The second dimension of collaboration is partnership. Partnership refers to the ability of collaborative groups to develop a strong sense of personal commitment to and identification with the workgroup and the collective goals of the workgroup. For this reason, partnership is seen to strengthen the ability of the group to consistently achieve its goals. Finally, the third dimension of effective collaboration is group interdependence meaning that group members learn to depend on and trust one another so that the contributions of each group member support the collective efforts of the entire group.

As key dimensions of collaboration, sharing, partnerships, and interdependence emphasize the importance of relationships as an effective approach to coordination. For this reason, the collaboration literature offers an alternative perspective of work coordination that extends beyond the use of programming through rules, procedures, and work standardization. In contrast, the dimensions of collaboration can be seen as consistent with the traditional view of feedback as a component of work coordination because each dimension addresses the importance of co-worker interactions and reciprocal feedback as essential for goal attainment.

Interprofessional collaboration is similar to other types of collaboration in that it also emphasizes the importance of sharing goals, power, and decision-making, partnerships, and interdependence as have been previously described. Theses dimensions are most comparable to the interpersonal support mechanisms of shared mental models, mutual trust and closed-loop communication as identified in the teamwork literature. However, both the teamwork and collaboration literatures identify different coordination approaches that are thought to be critical to effective group performance. In the teamwork literature, for example, teams are described as groups consisting of members who have a single designated leader, thus suggesting the need for vertical coordination of group members. In the interprofessional collaboration literature, teams are seen as groups of professionals who achieve effective performance by sharing their individual expertise, knowledge, and skill. As such, this literature emphasizes horizontal as opposed to vertical coordination of group members. Therefore, the teamwork and collaboration literature share similar features but also offer different yet complimentary perspectives about work coordination and its implications for group performance.

Interprofessional collaboration is especially important in health care organizations because optimal patient outcomes typically depend on the specialized expertise of multiple professional providers, each of whom brings a unique yet interdependent perspective about the needs of individual patients. As seen in the teamwork literature, the literature on interprofessional collaboration targets relationships among group members as an important dimension in achieving effectiveness. Therefore, both the interprofessional collaboration and work coordination literature share a common perspective on the importance of feedback as a coordination mechanism but differ in their view of programming which emphasizes task characteristics as a factor in identifying appropriate work coordination strategies.

Relational Coordination

Relational coordination, first introduced by Gittell in 2000, offers an alternative perspective to traditional work coordination because it addresses the interdependence and complexity that exists in organizations where goals can be achieved only through the effective functioning of multidisciplinary groups. The key dimension of relational coordination is high quality connections among organizational members, described by Gittell as the ability to recognize and respond to others in ways that permit effective and efficient goal attainment. These connections can be achieved through high quality communications and high quality relationships. High quality communications are defined as timely, frequent, accurate, and focused on problem- solving. High quality relationships are defined as interactions that are characterized by shared goals, shared knowledge, and mutual respect (Gittell, 2001, 2002, 2003).

According to Gittell (2003), organizations with highly interdependent work processes can achieve performance quality and efficiency by creating structures that support not only information flow as first described by Galbraith (1972) but also by creating structures that foster and support strong connections among workgroup members. Gittell used the term connections to describe organizational members who are linked together by their ability to consistently engage in high quality communications and sustain high quality relationships. Gittell suggested that organizations can be designed to enhance connections through the formation of boundary spanner roles, supervisory roles and routines. *Boundary spanners* are described as organizational members who collate, filter, translate, and interpret information. Although boundary spanners typically control the flow of information from the external environment, Gittell argued that boundary spanners also can control information between units within a single organization. For this reason, boundary spanners can facilitate strong relational coordination by providing the information that is needed so workgroups can participate in high quality communications and develop high quality relationships. Gittell used the phrase *supervisory roles* to acknowledge the guidance that organizational leaders can provide in coordinating work activities to achieve strong relational coordination. For example, organizational leaders can create a supportive climate that encourages groups to actively engage in high quality relationships, directly facilitate communication, and intervene to promote positive group processes. Finally, *routines* are identified as a factor that promotes strong relational coordination. The term routines was used by Gittell to suggest that high quality communications and high quality relationships are enhanced through the experiential learning that occurs when group members work together over time.

Along with the specification of factors that can enhance relational coordination, Gittell also proposed a relationship between relational coordination and organizational performance. Although Gittell did not specifically discuss quality and efficiency as performance criteria, she argued that high quality relational coordination contributes to better quality and more efficient performance especially among organizations where the work is highly interdependent and complex. The relationship between relational coordination and organizational performance is based on the premise that high quality connections among workers contribute to effective performance.

In summary, relational coordination shares many of the characteristics that were found in the literature on work coordination, teamwork and interprofessional collaboration (see Figure 3). Traditional coordination, teamwork, interprofessional collaboration, and relational coordination (see Table 6) share a common understanding of feedback as an important mechanism for work coordination. However, teamwork and interprofessional collaboration differ from traditional coordination by giving limited to no attention to programming as a central dimension of coordination. While the relational coordination literature also gives limited attention to programming as described by March and Simon (1958), Gittell does identify routines as a factor that contributes to high quality relationships

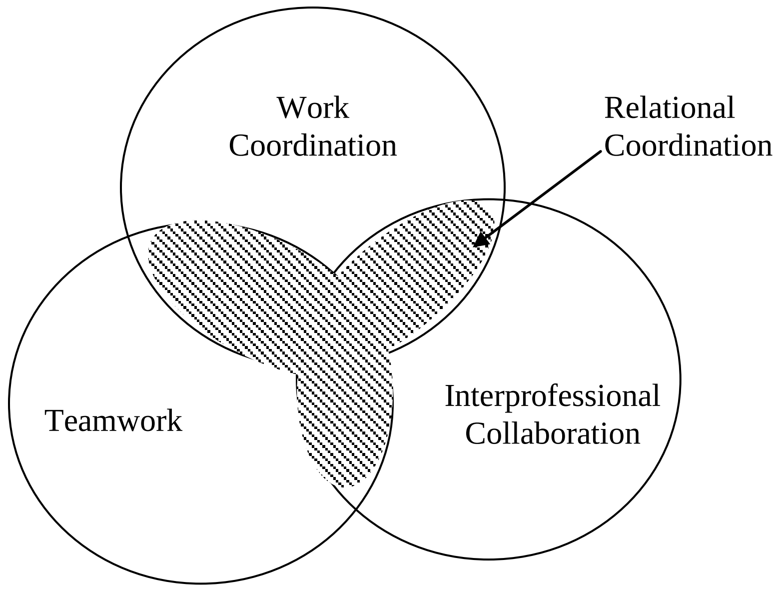

Figure 3. Integration of work coordination, teamwork, interprofessional collaboration, and relational coordination.

and communications among group members.

Integration of teamwork, interprofessional collaboration, and relational coordination.

Teamwork, interprofessional collaboration, and relational coordination provide an expanded conceptualization of how work can be coordinated to achieve optimal group performance and, ultimately, attain organizational goals. Yet, each of these concepts differs in several important ways. These differences can be summarized into four categories: broad- versus detail-oriented; vertical versus horizontal relationships; personal versus professional relationships; and communication. Focusing on *broad- versus detail-orientation*, the teamwork, interprofessional collaboration, and relational coordination literature recognizes shared goals and knowledge as important to effective team performance and the attainment of organizational goals. However, interprofessional collaboration and relational coordination focus broadly on high quality relationships but do not identify specific group behaviors that are indicative of quality. Although high quality relationships are addressed in the teamwork, interprofessional collaboration and relational coordination literatures, the teamwork literature gives greater detail by identifying interpersonal supportive mechanisms through which teams can function as an interconnected whole and suggesting group behaviors that are indicative of quality. For example, monitoring, delegating, instructing, and coordinating are recognized in the teamwork literature as important leader behaviors with back up behaviors and mutual performance monitoring as important group member behaviors. These behaviors then are recognized as important to the ability of strong teams to rapidly adapt to different situations.

Relationships are central to the teamwork, interprofessional collaboration, and relational coordination literature. In fact, horizontal coordination among group members is identified in the literature addressing each of these concepts. However, the teamwork literature suggests that group members can designate, depending on the specific situation, one person to lead the group and describes specific leader behaviors that contribute to effective teamwork. As such, the teamwork literature emphasizes both horizontal and vertical coordination among group members as key dimensions of effective teamwork. The interprofessional collaboration literature suggests that informal group leaders can emerge but does not address leadership behaviors that are critical to effective group performance. On the other hand, Gittell (2003) included supervisory roles as a factor in promoting high quality relational coordination. Although these roles can be seen as similar to team leader behaviors, supervisory roles are not as prominent in the relational coordination literature as they are in the teamwork literature.

Third, these three concepts differ in their emphasis on personal and professional relationships. In the teamwork and interprofessional collaboration literature, the value of negotiations among individual group members is addressed as a way to create win-win situations that maximize both individual and group goals. Therefore, these concepts incorporate both professional and personal goal attainment as important dimensions of effective group performance. In contrast, relational coordination addresses high quality relationships among professional workgroups but ignores personal relationships and the attainment of individual goals as a dimension of group performance.

All three concepts recognize the importance of communication in achieving effective group performance but each offers a slightly different perspective on communication. By focusing on closed-loop communication, the teamwork literature addresses how information should be transmitted among group members. In particular, this literature suggests that certain types of information should be consistently directed to specific group members. This approach increases accountability by identifying the group member who is responsible for a specific task and can provide ongoing feedback and clarification. Relational coordination, on the other hand, does not focus on the best approach to communication among group members but, rather, identifies attributes of effective communication in terms of timeliness, frequency, accuracy, and an emphasis on problem-solving. Communication as described in the teamwork and relational coordination literature, therefore, differs from the description of communication in the interprofessional collaboration. While communication is seen as important to effective interprofessional collaboration, details about the content that needs to be communicated and the best approach for transmitting information to group members are not well described in the interprofessional collaboration literature.

Integrated Review of the Literature

Studies included in this literature review were identified using Business Source Premier and MEDLINE. A Google search also was done to identify the most recent research on relational coordination. This literature review was limited to studies conducted in acute care hospitals, reported in English, and published within the last 10 years. First, literature addressing the relationship between structure and effectiveness is reviewed. Specifically, studies examining relationships among medication errors and length of stay as manifestations of effectiveness and teamwork, interprofessional collaboration, and, finally, relational coordination as manifestations of structure will be presented. Following this, literature on the relationship between context and effectiveness as manifested by medication errors and length of stay will be presented with specific emphasis on nursing unit environment as manifested by patient volume, workload, and support service availability and nursing unit technology as manifested by work complexity and patient acuity. Findings from these studies along with the theoretical literature on SCT are used to propose the contingency hypotheses that were tested in this study.

Relationships between Unit Structure and Unit Effectiveness

Studies focused on the relationships among relational coordination and related concepts like interdisciplinary collaboration, coordination, team/teamwork as structural variables and unit-level effectiveness in terms of quality and efficiency will be reviewed. For the purpose of this review, length of stay is treated as a manifestation of efficiency and medication errors is treated as a manifestation of quality.

Coordination and patient length of stay. Among the studies conducted to investigate interprofessional collaboration or teamwork, there is general consensus that better coordination improves group performance which, ultimately, may contribute to shorter lengths of hospital stay (Bennett, Fosbinder, & Williams, 1997; Chiocchio, 2007; Edwards, Day, Arthur, & Bell, 2006; Gibson, 1999; Gittell, 2000, 2001; Harris, Treanor, & Salisbury, 2006; Jansen, Van Den Bosch, & Volberda, 2006; Lin & Wan, 1999; Morey et al., 2002; Reagans, Argote, & Brooks, 2005; Tschan et al., 2006; Yen & Lo, 2004). Yet, studies to investigate specific approaches to coordination like team meetings, designated coordinators, teamwork or communication training, and information technology support have resulted in mixed findings. Although some researchers have found that these coordination approaches are associated with reduced lengths of patient stay (Bennett et al., 1997; Cohn, Rosborough, & Fernandez, 1997; Nichols & Zallar, 1997; Ruttimann & Pollack, 1996; Yen & Lo, 2004), others who have tested similar approaches have been unable to document such a relationship (Pollack & Koch, 2003; Rubin, Littenberg, Ross, Wehry, & Jones, 2005; Wild, Nawaz, Chan, & Katz, 2004). Specifically, Tschannen and Kalisch (2009a) studied relationships among nurse-physician coordination, actual length of patient stay, and deviations from the expected length of stay. Better nurse-physician collaboration was associated with longer lengths of stay. However, it also was associated with fewer deviations from the expected length of stay. In other words, better nurse-physician coordination was associated with a longer lengths of patient stay but the lengths of stay were consistent with expectations.

Support for an association between relational coordination and length of stay remains unclear. Gittell et al. (2000) and Gittell (2002) found a significant relationship between relational coordination and length of stay, with higher quality relational coordination associated with lower lengths of stay. In addition, Gittell (2002) found that relational coordination mediated the relationship between routines, boundary spanners, and supervisory roles in hospitals and patients' length of stay. In other words, high quality relational coordination, achieved through the use of routines, boundary spanners, and supervisory roles, was associated with shorter stays. In contrast, Brewer (2006) found a positive relationship between relational coordination and length of stay, with higher quality relational coordination associated with longer lengths of stay. These discrepant findings may be attributed to key differences in these studies. The two studies by Gittell et al (2000) and Gittell (2002) were conducted in nine hospitals and data were analyzed using the hospital as the unit of analysis. Brewer's study, on the other hand, was conducted at the unit level using data from medical-surgical nursing units. Therefore, the linkage between relational coordination and length of stay remains unclear.

Coordination and medication errors. Studies suggest that effective teamwork is associated with better patient outcomes. Teamwork has been linked to reduced failure to rescue and mortality rates (Pollack & Koch, 2003; Young et al., 1997), successful patient treatment (Faraj & Xiao, 2006), patient comfort (Yen & Lo, 2004), reduced urinary tract infections (Boyle, 2004), and fewer disease-specific complications (Boyle, 2004). More specifically, several studies have identified teamwork as a factor in reducing medication errors (Kaissi, Johnson, & Kirschbaum, 2003; Morey et al., 2002; Pratt et al., 2007; Schmitt, 2001).

The importance of both communication and coordination among physicians, nurses and pharmacists have been identified as components of effective teamwork. For example, Schmidt and Svarstad (2002) emphasized the need for effective nurse-physician and nurse-pharmacist communication as a way to enhance medication safety in terms of proper dosing and drug selection. In addition, Kopp, Erstad, Allen, Theodorou, and Priestley (2006) found that when pharmacist attended morning rounds, drug effects could be more rapidly clarified and drug interactions appropriately examined. Although communication is key to successful reductions in medication errors (Agency for Healthcare Research and Quality 2003; Dutton, & Heaphy, 2003; IOM, 2001), high quality relationships in which providers share knowledge and goals and also engage in mutually respectful interactions are needed. In other words, communication can be frequent, accurate, timely, and focused on problem solving but still be ineffective if team members do not respect each other.

In recent years, the Agency for Healthcare Research and Quality (2006) developed an evidence-based teamwork program called TeamSTEPPS™ that is designed to optimize patient outcomes by improving health care professionals' communication and teamwork skills. When health care professionals engage in frequent, accurate, timely, and problem solving communication, information about a patient can be rapidly communicated to those providers who can take appropriate and immediate action. Specifically, the TeamSTEPPS™

program emphasizes the goal of achieving better patient outcomes through the development of effective communication skills as well as high quality relationships. As with the evaluation of other team training programs, preliminary studies suggest that TeamSTEPPS™ training is associated with positive outcomes in terms of knowledge, skills, and attitudes. However, the effectiveness of these programs in terms of improved patient outcomes has yet to be demonstrated (Clark, 2009; King et al., 2006; Shapiro et al., 2004; Stead et al., 2009).

Although no studies were identified in which interprofessional collaboration and medication errors were investigated, Baggs and colleagues (1992) reported fewer ICU readmissions and deaths on a medical intensive care unit where nurses and residents collaborated about patient transfer decisions. In a follow up study, Baggs and colleagues (1997) again reported a relationship between patient outcomes on three intensive care units and the quality of nurse-physician collaboration, with better patient outcomes achieved on units where nurses and physician collaborated about patient care decisions. Despite these findings, Sullivan (1998), in a summary of the interprofessional collaboration literature, concluded that collaboration does not always improve patient outcomes but also has no negative or harmful effects.

No studies were found in which the relationship between relational coordination and medication errors was investigated. However, Gittell et al. (2000) found initial evidence of a possible linkage between relational coordination and better patient outcomes. In a study using nine hospitals, Gittell found that relational coordination was associated with better pain control but not improved postoperative functioning among surgical patients.

Despite discrepancies in the research literature, SCT theorists have consistently argued that context and structure have implications for organizational effectiveness. In other words, the work in hospitals is highly complex and uncertain, resulting in the need for continuing adjustment in work activities and collaborative participation in resolving work exceptions. For these reasons, horizontal coordination with reciprocal interactions among health care providers is identified by SCT theorists as an important dimension of structure when the organizational context is characterized by high work complexity and uncertainty (Alexander & Randolph, 1985; Leatt & Schneck, 1982; Nidumolu, 1996; Perrow, 1967). Relational coordination, in particular, has implications for effectiveness in hospitals because it broadens the focus of coordination to include not only consideration of the work itself but also the need for high quality horizontal relationships and timely, frequent, and accurate communication to resolve uncertain situations. According to SCT theorists, horizontal communication increases the capacity to process information in response to task and environmental uncertainty (Fry & Slocum, 1984; Galbraith, 1972; Hollenbeck, 2002; Tushman, 1979). For this reason, it is probable that coordination mechanisms like relational coordination that promote high quality relationships and communication is associated with effective group performance and, thus, better patient outcomes. Therefore, the following hypotheses were proposed:

Hypothesis 1 (H1): Nursing units with higher quality relational coordination will be associated with shorter lengths of patient stay.

Hypothesis 2 (H2): Nursing units with higher quality relational coordination between nurses and physicians and nurses and pharmacists will be associated with fewer medication errors.

Unit Context and Unit Effectiveness

Consistent with SCT, nursing unit context is conceptualized as having two major constructs: environment and technology. Although SCT does not specifically address the relationship between context and effectiveness, this section of the literature review describes findings from studies in which relationships have been examined among unit environment (as manifested in patient volume, workload and support service availability), unit technology (as manifested in work complexity and patient acuity), and unit effectiveness (as manifested in length of hospital stay and medication errors). Along with propositions from SCT, findings from these studies will be used to support the hypotheses that were tested in this study, specifically that the relationship between structure and effectiveness is contingent on organizational context. Specific contingency hypotheses are proposed following the discussion of research findings for each of the contextual variables included in this study.

Unit environment and unit effectiveness. Studies to investigate the relationship between *length of stay and unit size* as an indicator of input volume have been limited. Ruttimann and Pollack (1996) found that pediatric intensive care unit size predicted length of stay, with larger units having lower length of stay. In contrast, Clark and Normile (2002) found that higher patient volume in an emergency department contributed to treatment delays like delayed administration of a newly prescribed medication and transfer to an intensive care unit. These delays, in turn, were linked to longer lengths of patient stay.

Studies to describe the relationship between *medication errors* and *unit size* also are limited. Although some studies suggest that medication errors are more common among larger units and units with higher occupancy rates (Holley, 2006; Valentin et al., 2009), Barker et al. (2002) have found no relationship between size and medication error rates.

Despite these discrepant findings, SCT researchers argue that, unlike the larger organization which must constantly respond and adapt to the external environment, employees at the subunit level typically respond only to specific elements from the external environmental that are relevant to their work (Leatt & Schneck, 1982). As a result, the primary source of environmental uncertainty at the work unit level is patients who can be seen as inputs from the organization's external environment. Therefore, unit size is included as a structural contingency because size is the primary determinant of work volume and, thus, increased uncertainty and unpredictability at the unit level (Argote, 1982; Ford & Slocum, 1977; Starbuck, 1965). Greater uncertainty and unpredictability have critical implications not only for information processing at the level of the clinical microsystem but also for the structural form that is most likely to result in unit effectiveness (Galbraith, 1972). Argote (1982), for example, used volume of patients admitted to the emergency department at six hospitals to examine input uncertainty as a manifestation of unit environment. She found that when input uncertainty was high, the use of non-programmed approaches to coordination was associated with increased quality of care and clinical efficiency. Therefore the following contingency hypotheses were proposed:

Hypothesis 3A (H3A): As unit size increases, higher quality relational coordination will be more strongly associated with lower lengths of patient stay.

Hypothesis 3B (H3B): As unit size increases, higher quality relational coordination will be more strongly associated with fewer medication errors.

Numerous studies have documented a positive relationship between nurses' *workload and length of stay* (Decker, 2008; Garretson, 2004; Ong, Bostrom, Vidyarthi, McCulloch, & Auerbach, 2007; Padilha, de Sousa, Queijo, Mendes, & Reis Miranda, 2008; Schultz, van

Servellen, Chang, McNeese-Smith, & Waxenberg, 1998; Shamian, Hagen, Hu, & Fogarty, 1994). However, the relationship between workload and length of stay may differ depending on the approach used to measure workload. Decker (2008) found that workload in terms of inadequate RN staffing levels were associated with longer lengths of stay. Similarly, Garretson (2004) measured workload using nurse-patient ratios and found that heavier workloads on the day of patient admission and especially in the absence of backup resources was associated with increased inpatient mortality and length of stay. Others have measured workload using nursing care hours per patient day. Schultz et al. (1998) and Shamian et al. (1994) found that more hours of nursing care per patient day was associated with shorter lengths of stay. However, Tschanmen and Kalish (2009) found that more hours of nursing care per patient day was associated with longer lengths of stay and greater deviation from expected lengths of stay. Finally, Padilha et al. (2008) used nursing activities scores to measure workload and found that heavier workloads were associated with longer length of stay.

In general, studies have documented a positive relationship between *workload and medication errors* (Bohand et al., 2009; Carlton & Blegen, 2006; Chuo, Lambert, & Hicks, 2007; McKeon, Fogarty, & Hegney, 2006; O'Shea, 1999; Tansriprapasiri & Speedie, 2008; Teinila, Gronroos, & Airaksinen, 2008). In fact, researchers have consistently identified heavy workloads as a key factor in the causation of medication errors (Jacobs et al., 2007; Latter, Yerrell, Rycroft-Malone, & Shaw, 2000; Pham et al., 2008; Tang, Sheu, Yu, Wei, & Chen, 2007; Tissot et al., 2003). For example, Valentin et al. (2009) found that workload was a contributing factor in 37% of all medication errors on nursing units. Overall, these studies suggest that nurses may shift their attention away from medication administration and take short-cuts when preparing medications when their workload is heavy.

Studies to investigate the relationships among nurses' workload, length of stay, and medication errors suggest that the relationship between unit structure and effectiveness may be contingent on workload. However, no studies have examined the structure-context fit between nurses' workload and relational coordination and its relationship with unit effectiveness. However, workload was included as a structural contingency in this study because SCT theorists suggest that heavier work demands increase both information needs and the amount of information that must be processed. Both of these factors can exceed the information processing capacity of the nursing unit (Huber et al., 1975; Streufert & Driver, 1965). Thus, workload as a manifestation of the nursing unit environment can have direct implications for the management of uncertainty. Based on this argument, the relationship between relational coordination and unit-level effectiveness in terms of length of stay and medication errors may vary depending on the average workload on the nursing unit. Therefore the following hypotheses was tested:

Hypothesis 4A (H4A): As unit workload increases, higher quality relational coordination will be more strongly associated with lower lengths of patient stay.

Hypothesis 4B (H4B): As unit workload increases, higher quality relational coordination will be more strongly associated with fewer medication errors.

Support services availability refers to the number and type of resources like patient transporters, couriers for specimen collection, unit-dose systems, and computerized physician order entry (CPOE) that are available on the nursing unit. Although it is likely that greater support services availability is associated with better patient outcomes, studies to investigate resource availability like CPOE, information systems, and unit-dose systems, in particular, have yielded mixed results in terms of patient outcomes. Shulman, Singer, Goldstone, and Bellingan (2005) found that CPOE was associated with better patient outcomes. Yet, Han et al. (2005) found that mortality rates increased 2.8% following implementation of CPOE in a single hospital. Despite Han's study, most studies identify CPOE and other electronic information systems as factors that contribute to improved patient outcomes by increasing timely access to patient information, reducing redundancy in the use of diagnostic tests and procedures, reducing transcription errors, reducing the complexity associated with drug processing, and reducing errors through drug interaction checking and removal of high risk drugs (Amarasingham, Plantinga, Diener-West, Gaskin, & Powe, 2009; Butler et al., 2006; Collin et al., 2008; Eslami, de Keizer, & Abu-Hanna, 2008; Holland, Smith, & Blick, 2006; Rex, Turnbull, Allen, Vande Voorde, & Luther, 2000).

Current literature suggests an inverse relationship between *support services availability* (with electronic information systems as the most frequently studied) *and length of stay*. Most studies have found that increased access to electronic patient information systems is associated with reduced length of stay (Kuperman & Gibson, 2003). Amarasingham et al. (2009) found that information access improved following medical record automation and improved access was associated with a 15% reduction in length of stay. Amarasingham and colleagues concluded that automation increased the amount of time and information that was available for clinical decision-making. In addition, Holland et al. (2006) found that automation of the laboratory system in emergency departments permitted frequent and accurate updates on laboratory results which were associated with reduced lengths of stay. Similarly, Tierney, Miller, Overhage, & McDonald (1993) provided microcomputer workstations to permit electronic entry of all inpatient orders. Although these researchers did not find a statistically significant reduction in length of stay, units with microcomputer workstations reported a 0.89 shorter length of stay when compared to units without such workstations. Similarity, Mekhjian et al (2002) did not find a significant reduction in length of stay (0.07 days) following CPOE introduction in a general hospital. However, these researchers did find a significant reduction in length of stay (0.21 days) following CPOE introduction in a university hospital.

Investigation of the relationship between *support service availability and medication errors* has yielded mixed results. Rex et al. (2000) and Wu, Laporte and Ungar (2007) linked fewer medication errors to the use of CPOE. This finding was supported by Shulman et al. (2005) who found that medication errors were reduced by 1.9% when CPOE rather than hand written prescriptions was used. However, FitzHenry et al. (2007) pointed out that CPOE does not reduce errors that are associated with medication administration. In fact, Koppel et al. (2005) identified 22 CPOE system problems that can result in medication errors like fragmented displays that prevent a coherent view of patients' medications, pharmacy inventory displays that are mistaken for dosage guidelines, ignored antibiotic renewal notices, separation of functions that facilitate double dosing and incompatible orders, and inflexible ordering formats that result in erroneous entries. These findings are consistent with those reported by Pham et al. (2008) who found that CPOE systems contributed to an increase of 2.5% in medication error rates. Unit dosing systems also have been studied as a support service that may be associated with reduced medication errors. Specifically, unit-dose systems simplify and regulate the medication administration process which can eliminate the need for calculating, measuring, preparing, and delivering the exact dose for an individual patient (Fontan, Maneglier, Nguyen, Loirat, & Brion, 2003; Kohn, Corrigan, Donaldson, & McKenzie, 2000). Fontan et al. (2003), for example, found that medication errors were significantly reduced when a unit-dose system was implemented in combination with CPOE.

No studies have investigated support service availability as a contingency that affects the relationship between relational coordination and unit effectiveness. However, support services availability was included as a manifestation of the unit environment in this study because it is indicative of the resources that are available to support the transformation process (Pfeffer & Salancik, 1978; Sharfman & Dean, 1991; Yuchtman & Seashore, 1967). Organizational theorists argue that effectiveness is improved when the work environment is munificent, meaning that it provides sufficient resources to support the process of transforming inputs to outputs (Aldrich, 1979; Sharfman & Dess, 1991; Starbuck, 1976). In addition, availability of support services at the unit level provides nurses with more time to appropriately respond to uncertainty resulting from fluctuating patient demands, Therefore, the following contingency hypotheses were proposed:

Hypothesis 5A (H5A): As the availability of support services increases, higher quality relational coordination will be more strongly associated with lower lengths of patient stay.

Hypothesis 5B (H5B): As the availability of support services increases, higher quality relational coordination will be more strongly associated with fewer medication errors.

Unit technology and unit effectiveness. Technology is the second major contextual construct of SCT. Specifically technology refers on attributes of the transformation process in which inputs are converted to outputs. In this study, patient acuity and work complexity were treated as manifestations of unit technology. In this section, studies to examine the relationship between context (as manifested in patent acuity and work complexity) and effectiveness (as manifested in length of patient stay and medication errors) will be presented. Findings from these studies along with the key premise of SCT were used to develop contingency hypotheses to test the relationship between unit technological-structural fit and effectiveness.

Although most studies treat patient acuity as a control variable (Buckley, Castillo, Killeen, Guss, & Chan, 2009; Goodney, Stukel, Lucas, Finlayson, & Birkmeyer, 2003; Kiekkas et al., 2008; Mekhjian et al., 2002; Song, Srinivasan, Plaut, & Perl, 2003), a positive relationship between *patient acuity and length of stay* has been documented in several studies (Chant, Wilson, & Friedrich, 2006; Crandall, Shapiro, Worley, & West, 2009; Ritter-Teitel, 2004). Typically, patient acuity has been measured using either a disease-specific indicator of acuity or admission to a specialized patient care area like an intensive care unit (Gillespie et al., 2006; Gravel et al., 2009; Kiekkas et al., 2008; Walczak & Scorpio, 2000) or emergency department (Goldman et al., 2006; Yoon et al., 2003). However, other studies have found no relationship between patient acuity and length of stay (Blank et al., 2005; Dowdy, Robertson, & Bander, 1998). Dowdy et al. (1998), for example, found no difference in length of stay among terminally ill patients that were grouped according to acuity. However, these researchers did find that patients who participated in frequent communication with nurses and those who decided to forego life sustaining treatment tended to have a reduced length of stay.

Although it seems likely that patient acuity is associated with increased medication errors, evidence of a consistent relationship between *patient acuity and medication errors* is lacking. Although patient acuity typically is treated as a control variable in studies to examine factors associated with medication errors (Blegen, Vaughn, & Goode, 2001; McCloskey, 1998), several studies have documented a positive relationship between patient acuity and medication errors. Specifically, Rex et al. (2000) did a root cause analysis to explore common reasons for medication errors and identified patient acuity as a primary causative factor. Using different approaches to the measurement of patient acuity, Cullen et al. (1977) and Evans, Lloyd, Stoddard, Nebeker and Samore (2005) found that increased patient acuity was associated with greater risk of adverse drug events. Cullen et al. (1977) compared patients in intensive versus non- intensive care units and found that patient in an intensive care unit had nearly twice the rate of preventable adverse drug events compared to patients in a non-intensive care unit. Although other factors may contribute to differences in the work environment of intensive and non-intensive care units, patient acuity was a key difference in these patient populations. In addition, Evan et al. (2005) found a positive association between the number of patient comorbidities as a measure of patient acuity and adverse drug events. In contrast, however, Blegen, Goode and Reed (1998) found that nurses assigned to units with a higher than average patient acuity reported fewer medication errors but more non-medication-related adverse patient events.

In general, most studies indicate that higher patient acuity is associated with longer lengths of patient stay and more medication errors. However, no studies were found in which the fit between patient acuity and relational coordination and unit effectiveness were reported. Despite this, patient acuity can be seen as a relevant variable upon which the relationship between relational coordination and patient outcomes is dependent. Patients and their families represent the inputs that are converted to outputs during the transformation process in hospitals. The health care needs of high acuity patients and their families are diverse, rapidly changing, and often difficult to discern and treat. Higher patient acuity increases the need for coordination among multiple health care providers since the amount of knowledge that worker must bring to the transformation process increases as patient acuity increases (Comstock & Scott, 1977; Hrebiniack; 1974; Overton et al.,1977; Mohr, 1971; Rousseau, 1983). Patient acuity can be seen as a manifestation of unit technology because of its implications for task-related variability, uncertainty, manageability, and predictability, key dimensions of technology upon which the relationship between structure and effectiveness is contingent (Alexander & Randolph, 1985; Schoonhoven, 1981). Therefore, the following contingency hypotheses were tested:

Hypothesis 6A (H6A): As patient acuity increases, higher quality relational coordination will be more strongly associated with lower lengths of patient stay.

Hypothesis 6B (H6B): As patient acuity increases, higher quality relational coordination will be more strongly associated with fewer medication errors.

Although some researchers have used work complexity as a manifestation of environmental uncertainty (Allred, et al., 1994; Xiao, Hunter, Mackenzie, Jefferies, & Horst, 1996), others argue that it is a manifestation of technological uncertainty because it provides information not only about the raw materials that serve as organizational inputs but also about the work processes that are used to transform inputs to outputs (Fry & Slocum, 1984; Leatt & Schneck, 1984; Overton, et al. 1977). Despite the debate about work complexity as a manifestation of environmental or technological uncertainty, it is a frequently used measure of context at the work unit level (Allred, et al., 1994; Fry & Slocum, 1984; Geddes, Salyer, & Mark, 1999; Xiao, et al. 1996).

In general, a positive relationship has been found between *work complexity* and *length of stay* (De Jonge et al., 2001; De Jonge, Bauer, Huyse, & Latour, 2003; Li, 1999; Lobo, De Jonge, Huyse, Slaets, Rabanaque, & Lobo, 2007). Iapichino et al. (2002) classified the complexity of daily care into high and low categories and tested six different sequences: the provision of low complexity care to all patients; the provision of high complexity care to all patients; the initial provision of high followed by low complexity care; the provision of low followed by high complexity care; the provision of low followed by either high or low complexity care; and the provision of high followed by either low or high complexity care. These researchers found a non-linear relationship between work complexity and patient outcomes. Although a higher mortality rate was found for the group that required a longer interval of high complexity care, lower mortality was found among groups that received a shorter interval of high complexity care.

Work complexity is thought to contribute to the causation of *medication errors* (Buckle, Clarkson, Coleman, Ward, & Anderson, 2006; Schneider, 2002; Willeumier, 2004). However, only a limited number of studies have examined the linkage between work complexity and medication errors. Jacobs et al. (2007) identified six types of medication errors in acute care hospitals and linked these types to ten causal factors with one being case complexity. Similarly, Thomas & Brennan (2000) found that preventable adverse events like medication errors were more common among elderly patients and concluded that these errors could be traced to the clinical complexity of their care-related needs. Along with these studies, the cognitive demands that are associated with higher work complexity may contribute to an increase in medication errors. Some researchers have found a relationship between nurses' cognitive demands and medication errors (Elfering, Semmer, & Grebner

2006; Hicks, Becker, KrenZischeck, & Beyea, 2004; Hicks, Cousins, & Williams, 2004; Potter et al., 2005).

Gittell (2003) conceptualized routines as a factor in promoting high quality relational coordination and achieving optimal group performance. Although early organizational theorists viewed routines as a way to achieve coordination through work standardization, thus reducing the need for direct communication and feedback (Galbraith, 1972; Thompson, 1967; Van de Ven, Delbecq & Koenig, 1976), Gittell (2003) made the opposite argument by suggesting that routines actually enhance relational coordination especially when high levels of uncertainty can affect group performance. According to Gittell, routines are like recurring situations that allow group members to develop a shared understanding of how to interact in ways that make a meaningful contribution to the attainment of group goals (Adler, 1995; Adler & Borys, 1995; Feldman & Rafaeli, 2002). As a result, routines not only generate a shared understanding of group members' roles and actions, they also enhance adaptability to changing circumstances by generating high quality connections through which knowledge, expertise, and understanding can be effectively utilized (Gittell, 2003). Based on Gittell's argument, routines may contribute to better group performance not only when uncertainty is high but also when work complexity is high, since work complexity is seen as a key source of uncertainty on nursing units. In other words, Gittell's work suggests that the relationship between relational coordination and effectiveness may be contingent on work complexity. Therefore, it can be hypothesized that the relationship between relational coordination, length of stay, and medication errors is contingent on average work complexity on the nursing unit. Therefore, the following contingency hypotheses were proposed:

Hypothesis 7A (H7A): As work complexity increases, higher quality relational coordination will be more strongly associated with lower lengths of patient stay.

Hypothesis 7B (H7B): As work complexity increases, higher quality relational coordination will be more strongly associated with fewer medication errors.

Control Variables

Relationships among hospital and nursing workgroup characteristics and better patient outcomes have been documented in the literature (Blegen et al., 1998; Blegen, et al., 2001; McGillis Hall et al., 2004; McGillis Hall & Doran, 2004). The hospital characteristics of size, teaching status, and case mix index and the nursing workgroup characteristics of RN experience, unit tenure, educational preparation and overall nursing skill mix, however, will be statistically controlled in this study. This decision was made because the unit of analysis for this study is the nursing unit rather than the hospital and, in addition, SCT does not specifically identify workgroup characteristics as a manifestation of context.

Hospital characteristics and unit effectiveness. Most studies have controlled for hospital size when investigating the relationship between context, structure, and effectiveness (Hoffmann & Mark, 2006). However, Mitchell (2009) found that hospitals with a higher volume of patients reported shorter lengths of stay. In contrast, Cots, Mercade, Castells and Salvador (2004) found that larger hospitals reported longer lengths of stay. In addition, *hospital size* may be associated with medication error rates (Mark & Belyea, 2009).

In general, studies suggest that *teaching hospitals* achieve better patient outcomes compared to non-teaching hospitals (Ayanian, & Weissman, 2002; Ayanian, Weissman, Chasan-Taber, Epstein, 1998; Bhattacharyya, Mehta, Freiberg, 2008; Polanczyk, Lane, Coburn, Philbin, Dec, & DiSalvo, 2002). Specifically, Rosenthal, Harper, Quinn, and

Cooper (1997) compared teaching and non-teaching hospitals and found that risk-adjusted length of stay was 9% lower in major teaching hospitals than in non-teaching hospitals. In a follow-up to this study, Rosenthal et al. (1997) also found that major and minor teaching hospitals were similar in risk-adjust lengths of stay. In contrast, Carek et al. (2008) found that teaching status was associated with longer lengths of stay. Mark and Belyea (2008) used the number of medical and dental residents divided by hospital beds to measure teaching status and found that a higher ratio of medical and dental residents was associated with increased medication error over time.

Case mix index (CMI) is an indicator of annual intensity of resource utilization in a hospital (Friesner, Rosenman, McPherson, 2007). However, most studies do not investigate the relationship between CMI and patient outcomes and researchers typically use CMI to control for inherent differences in patient populations across hospitals (Feng, Grabowski, Intrator, Zinn, & Mor, 2008; Hadjianastassiou et al., 2007; Hays et al., 2006; Kendall-Gallagher & Blegen, 2009; Kuster et al., 2008; Latif, Signorini, & Whittle, 1998; Lee & Wan, 2002; Ramesh, Rao, Guha, & Thennarasu, 2008; Zinn, Feng, Mor, Intrator, & Grabowski, 2008). Despite this, Kainzinger, Raible, Pietrek and Müller-Nordhorn, Willich (2009), for example, argue that CMI is an important factor with respect to patient outcomes and, in fact, Mark and Belyea (2008) found that lower case mix index was associated with an increase in medication errors over time.

Nursing workgroup characteristics and unit-level effectiveness. *Nursing experience* has been positively linked to nurses' knowledge level, clinical judgment and decision-making ability, and comfort working with interdisciplinary colleagues (Benner, Tanner, & Chesla, 1992; Foley, Kee, Minick, Harvey, & Jennings, 2002; Lin & Wan, 1999;

Peden-McAlpine, 2000). Further, each additional year of nursing experience on a specific unit has been associated with fewer deaths in non-urban community hospitals (Tourangeau, Giovannetti, Tu, & Wood, 2002). Similarly, Blegen et al. (2001) found higher quality of care on units staffed with a higher proportion of experienced nurses. In contrast, Tschannen and Kalisch (2009b) found greater deviations from expected length of stay for patients who received care from more experienced nurses. Yet, Mark, Salyer and Wan (2003) found no relationship between nurse experience and length of stay.

Several studies have examined the relationship between nursing experience and medication errors. McGillis, Doran, and Pink (2004) found that nurses' experience was inversely related to the number of medication errors, but this result was not statistically significant. Similarly, Chang, Hughes and Mark (2006) found no relationship between nursing experience and medication errors. However, Blegen et al. (2001) found that fewer medication errors were reported on units staffed with a higher proportion of experienced nurses. Similarly, Chang and Mark (2009) found that units staffed with more experienced nurses reported more non-severe (but not severe) medication errors.

Few studies in the health care literature have examined the relationship between *unit tenure* and work coordination and results have been mixed. Although several studies have documented a positive relationship between group tenure and team performance (Eisenhardt & Schoonhoven, 1990; Reagans et al, 2005; Temkin-Greener, Gross, Kunitz, & Mukamel, 2004; Zhang, Hempel, Han, &Tjosvold, 2007), this relationship has not been supported in other studies where researchers have found that group tenure is not associated with team performance (Smith et al, 1994) or team decision quality (Amason, 1996). However, it is possible that the relationship between tenure and group performance is non-liner. Harrison, Mohammed, McGrath, Florey and Vanderstiep (2003) suggested that familiarity among group members may have short-term benefits by improving coordination efficiency. Over time, however, familiarity may actually result in social and friendship ties that can actually diminish group performance.

No studies were found in which the relationship between unit tenure and patients' length of stay was investigated. Further, Chang et al. (2006) and Chang and Mark (2009) found no relationship between unit tenure and medication errors. However, Roseman and Booker (1995) reported a higher incidence of medication errors among teams whose membership included temporary staff. Based on these findings, unit tenure will be treated as a control variable when examining the relationship between relational coordination and medication errors but not the relationship between relational coordination and length of stay.

Several researchers have suggested that, unlike their counterparts, baccalaureate-prepared nurses are more confident and more likely to actively engage in work behaviors like problem solving and effective communication (Aiken, Clarke, Cheung, Sloane & Silber, 2003; Baggs & Schmitt, 1997; Doran, Sidani, Keatings, & Doidge, 2002; Rose, Nelson, Johnston, & Presneill, 2008). In fact, some studies have found a positive relationship between nurses' *educational preparation* and better patient outcomes (Keenan, Cooke, & Hillis, 1998; Nelson, King, & Brodine, 2008; Porter, 1995; Reid, 1994; San Martin-Rodriguez, Beaulieu, D'Amour, D., & Ferradva-Videla, 2005). Aiken et al. (2003), for example, found that a 10% increase in the proportion of hospital nurses with a baccalaureate degree was associated with 5 % decrease in both the likelihood of a patient dying within 30 days of hospital admission and failure to rescue. Yet, other researchers have been unable to document a relationship between educational preparation and quality of care as an antecedent to better patient outcomes (Blegen et al., 2001; Doran et al. 2002; McGillis Hall et al., 2003; McGillis Hall & Doran, 2004).

Investigation of the relationship between nurses' educational preparation and patient's length of stay has been limited. Tschannen and Kalisch (2009b) used education level as part of their measurement of nursing expertise and found that greater nursing expertise was associated with longer than expected lengths of stay. Similarly, Chang et al. (2006) found that units staffed with a higher proportion of BSN-prepared nurses reported fewer medication errors. Finally, Chang and Mark (2009) found that units staffed with a higher proportion of BSN-prepared nurses reported fewer severe medication errors. When the proportion of BSN-prepared nurses reached 54%, however, the rate of severe medication errors did not decrease further.

Nursing skill mix can be defined as the composition of the nursing workgroup in terms of the proportion of RNs among the total nursing staff. Skill mix has important implications for determining the distribution of work on nursing units and the capacity of the workgroup to respond to the needs of highly complex patients. In general, studies have documented that a higher proportion of RNs on the nursing unit is associated with better patient outcomes (Anthony, 2008; Cho, Ketefian, Barkauskas & Smith, 2003; Kovner, & Gergen, 1998; Person et al., 2004; Tourangeau et al., 2002) and higher quality of care (McGillis Hall & Doran, 2004).

Along with these studies, researchers have identified an inverse relationship between *skill mix and length of stay*. For example, Kane, Shamliyan, Mueller, Duval and Wilt (2007) found that increasing RN proportion was associated with a 24% reduction in length of stay among intensive care patients and a 31% reduction in length of stay among surgical patients.

Similarly, Shamian et al. (1994) found that increasing the nursing care hours per patient day also reduced length of stay.

Studies suggest an inverse relationship between *skill mix and medication errors*. Blegen et al. (1998) and Blegen et al. (2001) found that more RN hours of care per patient day was associated with fewer medication errors. Further, Blegen et al. (1998) found out that the relationship between RN hours of care and medication errors was curvilinear, meaning that a threshold was reached at which point further increases in the proportion of RN hours of care per patient day was associated with more rather than fewer medication errors. Similarly, McGillis Hall et al. (2004) found that a higher proportion of professional nurses among the total nursing staff (RNs/LPNs) was associated with fewer medication errors. Finally, Mark et al. (2007) found that units with adequate RN staffing reported fewer medication errors but only when the safety climate on those units was poor.

Chapter Summary

In Chapter 3, a synthesis of the literature on work coordination with an emphasis on teamwork, interprofessional collaboration, and relational coordination was presented. Based on the review of literature and key propositions from SCT, twelve research hypotheses were proposed. In Chapter 4, the research methodology that was used to test these hypotheses is presented.

CHAPTER 4

RESEARCH METHODOLOGY

The purpose of this study was to test a theoretical model developed from structural contingency theory to explain the relationships among unit contextual-structural (relational coordination) fit and effectiveness (length of hospital stay and medication errors) on medical-surgical nursing units in acute care hospitals. This study was guided by the following research question as stated in Chapter 1: What is the relationship between contextual (unit size, workload, support service availability, work complexity and patient acuity) and structural (relational coordination) fit and effectiveness (length of patient stay and number of unit-level medication errors) on medical-surgical nursing units in acute care hospitals?

This study is a secondary analysis of data from the Outcomes Research in Nursing Administration II (ORNA-II) project, a multi-site organizational survey study conducted by Dr. Barbara Mark. In the first section of this chapter, the study purpose, research design, sample, and data collection procedures used in the ORNA-II study are described. In the second section, aspects of the parent study methodology that are specific to this study are presented. Finally, the procedures that were used to answer the research question for this study are described.

ORNA-II Study

Officially titled "A Model of Patient and Nursing Administration Outcomes," the ORNA-II study was a five-year project funded by the National Institute of Nursing Research

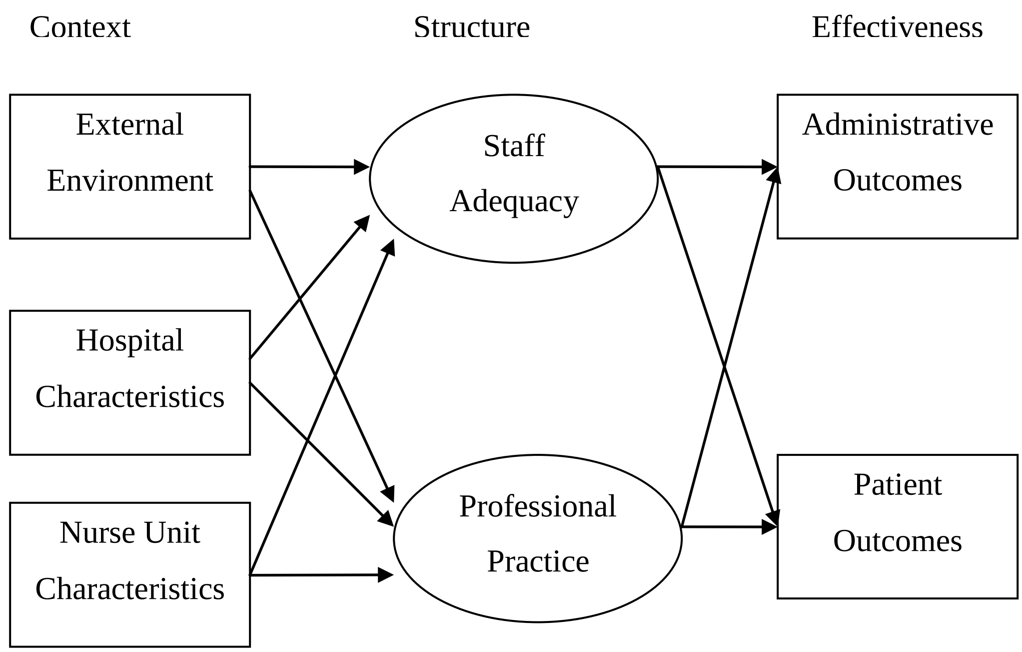

Figure 4. Theoretical framework used in the ORNA project

Note. Reprinted with permission of Dr. Barbara Mark (grant number 2R01NR031489). Using SCT as the theoretical framework, ORNA-II was conducted to investigate relationships among context (external environmental, hospital, and nursing unit characteristics), structure (staffing adequacy and professional practice model) and effectiveness (administrative, nurse, and patient outcomes). The theoretical model tested in the ORNA-II study is diagramed in Figure 4.

ORNA – II Research Design

ORNA-II was conducted using a non-experimental, longitudinal causal modeling design. ORNA-II is classified as a non-experimental study because it did not involve manipulation of an independent variable, use of a control group, and random assignment to groups, key characteristics of an experimental study (Brink & Wood, 1988). ORNA-II is also classified as a longitudinal study because data were collected at three time periods over six consecutive months. Although experimental designs provide the strongest support for causality, several steps were taken in the ORNA-II study to enhance the ability to make cause and effect inferences. First, the study was designed to permit time-ordered data collection with information on contextual variables obtained during the first round of data collection, information on structural variables collected during the second round of data collection, and information on effectiveness variables collected during the third round of data collection. The use of a longitudinal design minimized potential cohort effects which are macro conditions that can affect nursing unit characteristics over time and confound the data when a cross-sectional design is used (Anstey & Hofer, 2004). For example, a cohort effect in this study could have resulted from an infectious disease outbreak in certain regions of the United States during data collection. This approach strengthened the design in terms of identifying the effect of the independent variables on the dependent variables.

ORNA-II Sample

The sample for the ORNA-II study was JACHO-accredited, non-federal, not-for-profit, and non-psychiatric acute care facilities with more than 99 beds. Eligible hospitals were randomly selected from the 2002 American Hospital Association Guide to Hospitals. Recruitment continued until a total of 160 hospitals agreed to participate. Of these 160 hospitals, 14 withdrew before data collection started, resulting in a sample of 146 hospitals. Data were collected on two nursing units at each participating hospital. The selection criterion for units was that they had to meet the definition of a general medical-surgical or medical-surgical specialty unit (i.e., telemetry, orthopedic, oncology, or urology). Critical care, pediatric, obstetric and psychiatric units were excluded as were operating and emergency rooms, because these units differ in care delivery processes. If there were only two eligible units at a hospital, both units were included. If there were more than two units eligible for participation, an on-site coordinator selected by each hospital chose the units that participated. In total, 320 nursing units from 160 hospitals were recruited for the ORNA-II study. Because some hospitals withdrew from the study prior to completion of data collection, the final sample was 285 units from 144 hospitals (see Figure 5).

Registered nurses (RNs) on each unit were eligible to participate if they had been employed at least three months on their unit and provided direct patient care. Data also were obtained from ten patients, randomly selected from each unit. Patients who were eligible to participate included those over the age of 18, able to speak English, hospitalized on the unit at least 48 hours, and not scheduled for discharge on the day the questionnaire was completed.

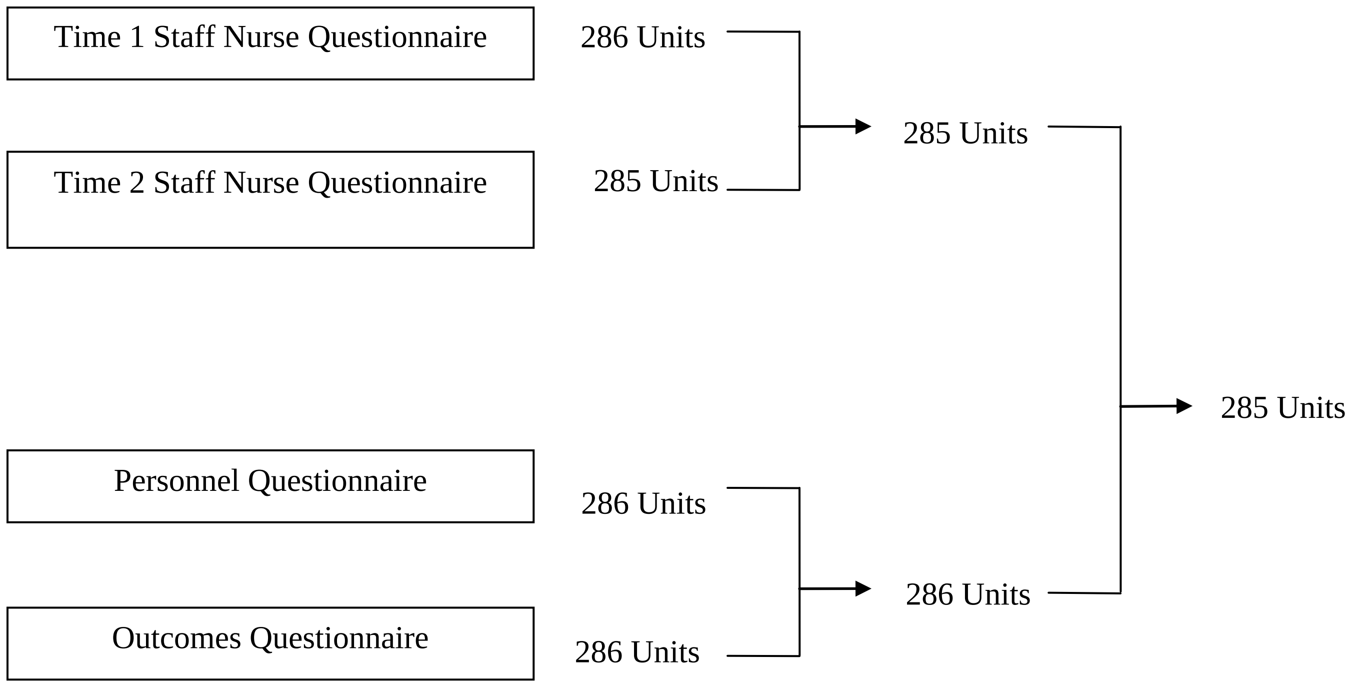

Figure 5. Sample matching for data analysis

ORNA-II Data Collection Procedures

The hospital sample for the ORNA-II was randomly divided into two groups, with data collected from the first and second group of hospitals during the first six months of 2003 and 2004, respectively. Although the timing of data collection may have resulted in differences between the two groups of hospitals, post hot analyses showed no significant difference between the groups.

Each hospital selected a study coordinator who managed the distribution and collection of data by administering questionnaires to nurses and patients and directly collecting selected unit-level administrative data. All study coordinators received 1.5 days of training provided by the ORNA-II research team. The purpose of the training was to introduce the aims and goals of the study, review and clarify the conceptual and operational definitions of key study variables, describe the data collection procedures, and share prior successful experiences with data collection. During data collection, members of the research team stayed in contact with study coordinators by telephone, e-mail, or fax to answer questions, correct errors in data reporting, and ensure data integrity. All calculations required for selected variables were performed by the research team to insure that consistent formulae were used and calculation errors avoided.

Four levels of analysis are represented in the ORNA-II data: community/market, hospital, nursing unit, and individual. Community/market level data for the year prior to data collection were retrieved from existing datasets obtained from the American Hospital Association (AHA). Data at this level reflected the external environment of a hospital which included geographic region, managed care penetration, and urban/rural designation. Hospital level data were collected by study coordinators during the first month of the six month data collection period. Data at this level focused on hospital characteristics like number of licensed beds, number of admissions and discharges, Magnet status, teaching status, and case mix index.

Separate questionnaires were used to measure characteristics of the nursing unit personnel, budget, and finances. Personnel data were obtained from study coordinators in consultation with the nurse manager on each unit. These data included nursing care hours delivered by all nursing personnel (RNs, LPNs, UAPs, agency, float, and contract nurses) collected during the first month of data collection. Data for RN FTEs, numbers of patient days, number of patient discharges, and patient length of stay were collected each month during the six month data collection period. Unit-level budget and financial data were obtained from study coordinators in consultation with the nurse manager on each unit. These data included information on finances and budget like total operating budget (i.e., revenues and expenses), personnel salaries, and expenditures for productive and non-productive time as well as overtime. Financial data were reported by the study coordinators first for January through March and then for April through June. Unit-level incident reports were used to measure medication errors and falls. Monthly data also were collected to measure the number of hospital-acquired infections (pneumonia and urinary tract infections) on each unit. A calendar summarizing the data collection points and data sources is provided in Table 7.

Individual level data were collected from eligible RNs on each participating unit. Three different questionnaires were completed during the six months of data collection. The first questionnaire included items measuring demographic characteristics, technological and work complexity on the unit, commitment to care and nursing expertise among the RN workgroup, and availability of support services. The second questionnaire included items measuring nurses' autonomy, participation in decision-making, relational coordination, perceived justice, and safety climate. The third questionnaire included items measuring nurses' job satisfaction and job enjoyment. In order to ensure the highest response rates for the nurse questionnaires, Dillman's (1978) Total Design Method was used. This method calls for three reminders, with the first reminder sent to nurses one week after they received the first questionnaire, followed by a second reminder and a duplicate questionnaire sent two weeks after the first questionnaire was distributed, and a third reminder letter sent two weeks later. The RN response rates were 75% at Time 1 (13.3-100%), 58% at Time2 (0-100%), and 54% at Time 3 (0%-100%) (see Figure 6).

Ten patients from each unit also completed a questionnaire that asked about satisfaction with nursing care during hospitalization and the extent to which expectations for symptom management were met. Along with these data, demographic information including age, educational level, history of hospitalizations, and perceived health status were obtained. The ten patients who completed the patient questionnaire were randomly selected by the study coordinators during the final month of data collection. In total, 2,991 questionnaires were distributed with data collected from 2722 eligible patients, resulting in a response rate of 91% (see Figure 5).

Current Study

Although the ORNA-II study used a longitudinal design with multiple data collection points, the current study used a descriptive, cross-sectional design because most of the variables included in this study were measured only once, with medication errors, patients' length of stay, RN hours, and RN proportion measured monthly for six consecutive months. Table 8 shows the data sources for the selected variables in this study. Although three levels of data were collected in the ORNA-II study, only unit-level data were analyzed in this study since the nursing unit was identified as the unit of analysis. Although the ORNA-II sample included 286 nursing unit, the final sample size for this study, due to missing data, was 285 units from 144 hospitals (Figure 5).

Definition and Measurement of Major Study Variables

In this section, the definitions and measurement approaches used in this study are presented. Specifically, the major concepts of this study were context, structure and effectiveness (see Figure 2). Context can be defined as any contingency factor that interacts either within or across organizational boundaries to influence organizational structure and, ultimately, effectiveness (Randolph, 1981). Context includes both environment and technology. The subconcept of environment was measured using unit size, workload, and support service availability. The subconcept of technology was measured using work complexity and patient acuity. The structural variable measured in this study was relational coordination. The effectiveness variables measured in this study were length of stay and medication errors. Table 9 summarizes the definition and measurement of these variables. The following section explains the definitions and measurement approaches for the variables that were used as manifestations of environment and technology. This section will be followed by sections that address the variables that were used as manifestations of structure and effectiveness.

Contextual variables. The environment can be defined as components of the external and/or internal environment that are relevant to organizational goal attainment (Duncan, 1972a). As described in Chapter 2, numerous variables have been studied as

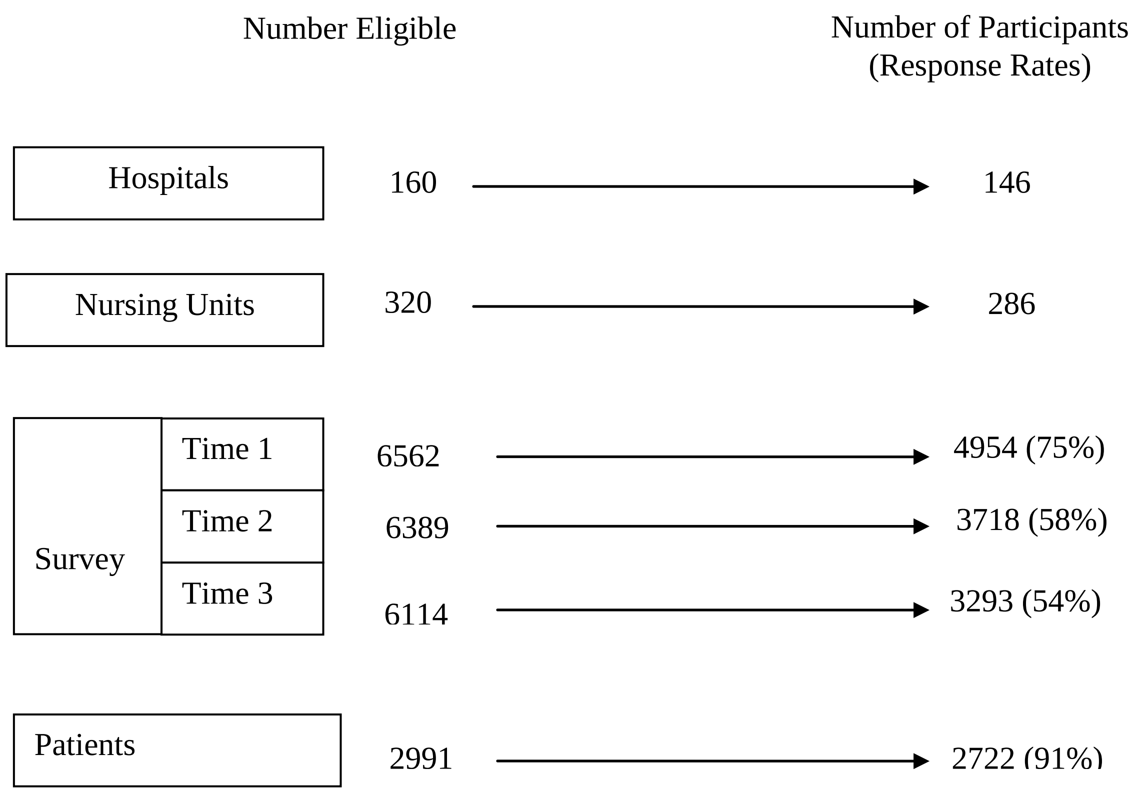

Figure 6. ORNA-II sample sizes and response rates

Table 7

Calendar of Data Collection Points and Source of Data

Study Instruments	Data source	January	February	March	April	May	June
Hospital Level							
Hospital Questionnaire	AHA	X					
Unit Level							
Personnel Questionnaires	Study Coordinator	T1	T1	T1	T2	T2	T2
Financial Questionnaire	Study Coordinator						X
Outcomes Questionnaire	Study Coordinator			X			X
Individual Level							
Staff Nurses Questionnaires	Staff Nurses	T1		T2		T3	
Patient Questionnaire	Patient						X

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3

Table 8

Sources of Data for Selected Variables

Study Variables	Data Sources
Contextual Variables	
Unit Environment	
Unit Size	Personnel Questionnaire
Workload	Personnel Questionnaire
Support services availability	Time 1 Staff Nurse Questionnaire
Unit Technology	
Work Complexity	Time 1 Staff Nurse Questionnaire
Patient Acuity	Time 1 Staff Nurse Questionnaire
Structural Variables	
Relational Coordination	Time 2 Staff Nurse Questionnaire
Nurse- Physician Relational Coordination	Time 2 Staff Nurse Questionnaire
Nurse- Pharmacists Relational Coordination	Time 2 Staff Nurse Questionnaire
Effectiveness Variables	
Patients' Length of Stay	Outcomes Questionnaire
Medication Errors	Outcomes Questionnaire
Control Variables	
Hospital Characteristics	
Size	Hospital Questionnaire
Teaching status	Hospital Questionnaire
Case Mix Index	Hospital Questionnaire
Workgroup Characteristics	
Nursing Experience	Time 1 Staff Nurse Questionnaire
Unit tenure	Time 1 Staff Nurse Questionnaire
Educational preparation	Time 1 Staff Nurse Questionnaire
Skill mix	Personnel Questionnaire

manifestations of the environment, including volume and attributes of the raw materials (patient) or inputs that are transformed to become outputs and the resources that support the transformation process. In this study, environment will be measured using unit size, workload, and support services availability.

Unit size can be seen as a manifestation of the volume of inputs that undergo the transformation process and was measured as the numbers of open and staffed inpatient beds on the unit. *Workload* was defined as the amount of the work that is required to care for the typical patient population(s) served on the unit and measured by dividing the total number of inpatient days over six months by the number of full-time equivalent RNs on the unit. *Support services availability* was defined as the extent to which support services like CPOE, transporters, venipuncture/blood specimen collection, and patient transporters are consistently available on the nursing unit. This variable was measured using a check list that included 21 support services that were rated by RNs as available, inconsistently available, or consistently available (Mark, 2002). The possible range of scores for this scale is 0 to 42, with higher scores indicating greater support services availability. This scale has a Cronbach's alpha of .80 (Mark et al, 2008).

Unit technology can be broadly defined as the internal operations that are used to transform inputs to outputs (Fry & Slocum, 1984; Pennings, 1975; Rousseau, 1983). According to Perrow (1967), these operations include the analytical skills that are required when exceptional cases are encountered. Therefore, work complexity and patient acuity were seen as manifestations of unit technology in this study.

Work complexity was measured by a seven-item Likert-type questionnaire developed by Salyer (1996). In this questionnaire, nurses rate the frequency of work-related interruptions or unanticipated events on their unit. A sample item from this scale is "frequent movement of patients on and off the unit for diagnostic studies, procedures, etc. makes it difficult for nurses on this unit to do a good job." This scale has six response options ranging from "strongly disagree" to "strongly agree" with higher scores indicative of greater work complexity. The possible range of scores for this scale is 7 to 42. This scale has a Cronbach's alpha ranging from 0.80 to 0.85 (Mark et al, 2008; Sayler, 1996). *Patient acuity* was measured using a 14-item Likert scale originally developed by Overton et al. (1977) and revised twice by Mark (1992; 2003). Items on this scale address the complexity of patient care needs on the unit as well as the demands that are required to provide patient care on the unit. This scale uses a frequency range of a few (<20%), some (21% to 40%), about half (41% to 50%), many (51% to 80%), and most (80% and above) to estimate the number of patients on the unit who have specific nursing care needs. A sample item from this scale is "How many patients on the unit require high technology equipment, immediate intervention or care from skilled nurses?" The possible range of scores for this instrument is 14 to 70. Cronbach's alpha reported for this scale is 0.81 (Mark, et al., 2007).

Organizational structure. Structure can be defined as the administrative mechanisms that are used to organize and coordinate work activities to achieve organizational goals. Structure was measured as the nurse-perceived quality of relational coordination on the nursing unit. *Relational coordination* is defined as coordination among different professionals that is characterized by frequent, timely, accurate and problem-solving communication and relationships that are based on shared goals, knowledge, and mutual respect (Gittell, 2002). Relational coordination was measured in the parent study using the Relational Coordination Scale (Gittell et al, 2000) which encompasses four communication (frequent, timely, accurate, and problem-solving) and three relationship (shared goals, shared knowledge, and mutual respect) dimensions. These dimensions were rated in terms of interactions with nine different health care provider groups: attending physicians, house staff, physical therapists, respiratory therapists, laboratory personnel, case manager/social workers, pharmacists, radiology personnel, and dietary personnel. The rating of communication frequency, timeliness, and accuracy is measured using a Likert-type scale with response options ranging from 1 to 5 (never, rarely, occasionally, often, and always). Problem-solving communication is measured as the extent to which others work to resolve problems or are blamed for problems. This item is rated on a 1 to 5 scale anchored by “only problem-solving” and “only blame.” The relationship dimension of sharing knowledge is measured as the extent to which other health care professionals know about the work nurses do on the unit. This item is rated on a 1 to 5 scale with options that included “not at all”, “a little,” “some,” “a lot,” and “everything.” Finally, the relationship dimensions of sharing goals and mutual respect is measured using a Likert-type scale with response options that included “not at all,” “a little,” “some,” “a lot,” and “completely.”

The Relational Coordination Scale was developed and validated using samples from the commercial airline industry (Gittell, 2000a, 2000b) and can be used to evaluate relational coordination in settings that are highly uncertain, interdependent, and time constrained. Gittell et al. (2000) adapted this instrument to health care settings by including "accuracy of communication" and deleting "helping across disciplines," since accuracy in health care settings is of critical importance and the potential for helping in these settings is typical. In the original validation study using data from five different professional samples, Gittell et al. (2000) reported Cronbach's alphas ranging from 0.71 to 0.84 and an overall index of reliability of 0.84. Mark et al (2007) reported a Cronbach's alpha of 0.80 for this scale.

For the purposes of this study, structure was manifested by two variables: overall relational coordination and relational coordination between nurses and physicians and nurses and pharmacists. The possible range of scores for the overall relational coordination scale was 63 to 315, with higher scores indicating higher quality relational coordination. The range of possible scores for relational coordination between nurses and physicians and between nurses and pharmacists was 14 to 70.

Two factors contributed to the decision to include a measure of overall relational coordination and a measure of relational coordination between nurses and physicians and nurses and pharmacists. First, relational coordination among multiple provider groups is identified as a key factor in the quality and comprehensiveness of the plan of care for individual patients and, thus, is most likely to influence average length of stay on nursing units. Similarly, the number of medication errors has been identified as most affected by relational coordination among nurses and physicians and nurses and pharmacist. For this reason, targeting these specific provider groups when examining medication errors increased measurement sensitivity. Finally, rather than treating the quality ratings for physicians and pharmacists as separate variables, the decision was made to sum the ratings for both provider groups into a single measure. This was done because the use of two separate measures would have exponentially increased the number of parameters to be estimated in the interaction model, resulting in a significant reduction in statistical power.

Effectiveness variables. Effectiveness refers to the ability of an organization to successfully achieve its goals both in terms of quality and efficiency. Two variables were used in this study to measure effectiveness: medication errors as a manifestation of quality and patients' length of hospital stay as a manifestation of efficiency. *Length of stay* was defined as the average number of days that patients received care on the nursing unit and measured as unit-level patient days per 1,000 days divided by the number of patient discharges during the final three months of ORNA-II data collection. *Medication errors* were defined as the number of severe medication errors documented by incident report on each nursing unit during the final three months of data collection for the ORNA-II project. Severe medication errors were defined as errors that require increased nursing observation, medical intervention, use of technology like technical monitoring, laboratory testing, and radiographic testing, or transfer of the patient to another unit. Severe medication errors were used in this study because these errors are less likely to be under-reported (Allan & Baker, 1990; Tamuz, Thomas, & Franchois, 2007; Wakefield, et al., 1999).

Definition and Measurement of Control Variables

Two sets of control variables were included when testing the relationships among contextual-structural fit and unit effectiveness in this study: hospital and RN workgroup characteristics.

Hospital characteristics. Hospital characteristics can be defined as secondary contextual attributes that have the potential to influence the transformation process in hospitals (Leatt & Schneck, 1982). The following hospital characteristics were measured and controlled for in this study: size, teaching status and case mix index. Hospital size was measured as the numbers of open and staffed inpatient beds. Teaching status was measured as the ratio of medical and dental residents to the number of hospital beds. Case mix index was measured using the Medicare case mix index for each hospital.

Workgroup characteristics. RN workgroup characteristics also can be seen as secondary contextual attributes because they give information about the qualifications of the staff who are involved in the transformation process. RN workgroup characteristics included nursing experience and unit tenure, basic educational preparation of the RNs on the unit, and skill mix of the nursing workgroup. Nursing experience was measured as the average number of months of nursing experience as reported by RNs on each nursing unit. Unit tenure was measured as the average number of months of experience on the current nursing unit as reported by RNs on each unit. Basic educational preparation was measured as the proportion of RNs on each unit with a baccalaureate degree in nursing or higher. Skill mix was defined as the composition of the nursing workgroup on each unit and measured as the number of RNs (including float, agency and temporary RNs) divided by the number of all nursing personnel (including RNs, LPNs, and other direct patient care staff).

Data Analysis

Unit of analysis and data aggregation. Although few SCT theorists have differentiated organizational context at the subunit level (Argote, 1982; Galbraith, 1972;

Table 9

Definition and Measurement of Study Variables

Variable	Definition	Measurement
Context Variables		
Unit Environment		
Unit Size	Numbers of unit beds	Number of open and staffed inpatient beds
Workload	Amount of the work required on the unit	Numbers of inpatient days over six months divided by the number of full-time equivalent RNs on the unit.
Support Services Availability	RN ratings of support services availability.	Consistent availability of 21 support services.
Unit Technology		
Work Complexity	RN perceptions of the work-related interruptions or unanticipated events.	Aggregated scores on Work Complexity Scale (Salyer, 1996).
Patient Acuity	RN perceptions of patient acuity on the unit.	Aggregated scores on Patient Acuity Scale (Mark, 1992; Mark, Harless, McCue & Xu, 2004; Overton et al., 1977)

Table 9 (continued)

Variable	Definition	Measurement
Structural Variables		
Overall Relational Coordination	Coordination among nine different professional groups that is characterized by frequent, timely and problem-solving communication and shared goals, knowledge, and mutual respect.	Aggregated scores on the Relational Coordination Scale (Gittell et al., 2000)
Relational Coordination between Nurses-Physicians and Nurses-Pharmacists	Relational coordination between nurses and physicians and nurses and pharmacists.	Aggregated scores on nurses-physicians and nurses-pharmacists ratings on the Relational Coordination Scale (Gittell et al., 2000)
Effectiveness Variables		
Patients' Length of Stay	Average number of patient days for the last 3 months.	Numbers of patient days divided by numbers of patients discharges.

Table 9 (continued)

Variable	Definition	Measurement
Severe Medication Errors	Number of incident reports documenting a medication error that required increased nursing observation, medical intervention, laboratory or radiologic testing, or transfer to another unit.	Number of incident reports documenting a severe medication error during March, April, May of parent study.
Control Variables		
Hospital Characteristic		
Size		Number of open and staffed inpatient beds
Teaching Status		Ratio of medical and dental resident to the number of hospital beds
Case Mix Index	Complexity of patient population.	Hospital's Health Care Financing Administration designation.

Table 9 (continued)

Variable	Definition	Measurement
Workgroup Characteristics		
Experience	Direct patient experience in a nursing role.	Average months of direct patient care experience as reported by RNs on the unit
Unit tenure	Nurses' unit experience in months	Average number of months of experience on the current nursing unit as reported by RNs on each unit
Educational preparation	Proportion of nurses with BSN degree or higher	Proportion of nurses with BSN or higher
Skill mix	Representation of RNs among the total nursing staff on the unit.	Number of RNs (including float, agency and temporary RNs) divided by the number of all nursing personnel (including RNs, LPNs, and other direct patient care staff) on the unit.

Ven de Ven & Delbecq, 1974), researchers typically identify two levels of analysis in health care organizations: the hospital and the nursing unit (Grimes & Klein, 1973; Leatt & Schneck, 1982; 1984). Further, the nursing unit is recognized as the basic work unit in hospitals (Leatt & Schneck, 1982). Therefore, the ORNA-II study was conducted at the nursing unit level. Specifically, environment and technology were measure at the nursing unit level. In addition, patient outcomes (length of stay and medication errors) were measured at the nursing unit level in the ORNA-II study. Items on the staff nurse questionnaires were written to elicit RN perceptions of the nursing workgroup rather than individual perceptions. Therefore, aggregating individual-level data to the nursing unit level was seen as an optimal approach for the statistical analyses that were used to answer the research question for this study. Justification for data aggregation was based on evidence that homogeneity of variance in RN ratings was greater within than between nursing units. Several statistical methods were used to justify aggregation of individual data to the unit level, including the rwg, eta-squared, intraclass coefficient or ICC (1), and mean rater reliability using ICC (2) (Klein & Kozlowski, 2000a; 2000b). Table 10 reports values for these statistics obtained from the data used in this study. In the following section, each of these methods and the interpretation of values will be discussed.

The rwg was developed by James, Demaree, and Wolf (1984) to measure score variability within a single unit (i.e., a nursing unit). The rwg is calculated by comparing within-unit variance to an expected random variance. If within-unit variability is smaller than the variability that can be expected by chance, the resulting rwg suggests that it is justifiable to aggregating individual ratings to the group (nursing unit) level. Values of the rwg can range from 0 and 1. Generally, an rwg value that is equal to or greater than 0.70

indicates high consistency within groups and, therefore, justifies data aggregation (Klein & Kozlowski, 2000a). The rwgs calculated for this study ranged from 0.80 to 0.94 and were considered adequate.

The eta-squared statistic and the intraclass coefficient or ICC (1) both use the one-way analysis of variance (ANOVA) to estimate the percent of variance in individual scores that can be explained by group membership. For example, a value of 0.28 for the eta-squared statistic suggests that group membership accounts for 28% of the variance in individual scores. In general, the eta-squared statistic and the ICC (1) provided similar estimates for groups consisting of more than 25 individuals. In contrast, the value of the eta-squared statistic will usually be larger than that for the ICC (1) when groups include fewer than 25 individuals. The average number of nurses per unit who participated in the ORNA-II study was 17.32. In this study, values for the eta-squared statistic and the ICC (1) were comparable, ranging from 0.16 to 0.30. These values suggested that 16% to 30% of RN score variability could be explained by membership on the nursing unit and values for the ICC(1) ranged from 0.12 to 0.26, suggesting that 12% to 26% of RN score variability could be explained by nursing unit membership (see Table 9). According to James (1982), ICC (1) values within the range of 0.00 to 0.50 with a median of approximately 0.12 are considered adequate justification for data aggregation.

The ICC (2) determines the reliability of the means within a group-level sample (Klein & Kozlowski, 2000b). ICC (2) is a function of both ICC (1) and group size (Bleise, 2000). Generally, ICC(2) values are higher among larger groups because group means are obtained from more individuals and, thus, tend to be more stable than is usually the case with smaller groups. For this reason, estimates of mean rater reliability of aggregated data using

ICC (2) typically are higher for larger rather than smaller groups. In this study, ICC (2) values ranged from 0.70 to 0.86 which met the 0.70 criterion recommended for data aggregation (Klein & Kozlowski, 2000a).

Statistical power. There is no a priori power analysis that is widely accepted for the analyses that were used in this study (mixed and mixed effect for count regression models). However, with a sample of the size that will be used in thise study, a multiple regression for a main effects model with five moderators and six control variables would detect a minimal effect of relational coordination on the outcomes of between 3 to 5% of total variance with 80% power with Type I error restricted to 5% . This level of power would be attained if the moderator and control variables had no more than 3% explanatory power as suggested in the observed correlations. The minimal detectable effect was specified as a range because it depends on the clustering of units within hospitals. In expanded models for investigating moderation effects, the minimal detectable effect for the set of moderators is between 5 to 8%.

Testing contextual-structural fit and effectiveness. As described in Chapter 2, several approaches to the evaluation of fit have been described in the organizational literature. Consistent with other studies conducted in health care settings (Alexander & Randolph, 1983; Argote, 1982; Schoonhoven, 1981), the moderation or interaction approach for evaluating fit was used in this study. Specifically, the role of contextual variables as a moderator of the relationship between structure and effectiveness was determined by creating interaction terms (value of the contextual variable multiplied by the value of the structural variable).

Two approaches can be used to test SCT hypotheses. First, each contingency hypothesis can be separately tested. Using this approach, separate models are analyzed to test each individual interaction term. The advantage of this approach is that the variance explained by each interaction term is uninfluenced by other interaction terms in the model. The disadvantage of this approach, however, is that multiple hypothesis tests must be performed which increases the risk for Type I error. In the second approach, one model that includes all interaction terms can be analyzed. The advantage of this approach is that it minimizes the potential for Type I errors. The disadvantage, however, is that the parameter estimates for each interaction term must be interpreted in light of all other variables in the model. Data for this study were analyzed using both a separate test for each fit hypothesis along with simultaneous testing of multiple fit hypotheses. Because both approaches resulted in similar findings, only the results obtained using the second approach are reported.

Most SCT researchers have used the second approach which allows for simultaneous testing of multiple contingency hypotheses (Argote, 1982; Gresov 1989; Joyce et al., 1982; Nidumolu, 1996; Schoonhoven, 1981). When using this approach, a main effect model is analyzed first to test relationships among contextual, structural and control variables. Following this, an interaction model is analyzed to test relationships among "contextual-structural" interaction terms and the effectiveness variables. This latter model includes the main effects of contextual, structural and control variables as well as the interaction effects of fit between contextual and structural variables. Inferences about model fit are based on evidence that a significant portion of variance in the effectiveness variables is accounted for by the other variables that were included in the model.

Two statistical assumptions were considered when choosing the analytic approaches used to answer the research question: the distribution of scores for the dependent variables

Table 10

Statistics for Data Aggregation

Study Variables	rwg	ICC (1)	ICC (2)	Eta-squared
Patient Acuity	.92	.12	.71	.17
Work Complexity	.80	.17	.78	.21
Support Services Availability	.84	.26	.86	.30
Relational Coordination	.94	.15	.70	.21
(RN-MD and RN-Pharmacist)				
Overall Relational Coordination	.86	.20	.77	.16

and clustering of data at the nursing unit level. Length of stay was measured as a continuous variable and, therefore, values are more likely to be normally distributed. In contrast, severe medication errors were measured as a count variable or the number of events that were documented within a specific time period. Count data are usually reported as non- negative whole number or integer values with a high frequency of zero values and a gradual reduction in frequency as values increase (Hutchinson & Holtman, 2005). Therefore, the distribution of count data is positively skewed. Because the distribution of values for length of stay and severe medication errors markedly differed, the decision was made to test each effectiveness variable using different statistical models.

The ORNA-II data were collected from two nursing units in each hospital. For this reason, these data can be described as nested or clustered since it is possible that units located in a single hospital might be similar to each other but very different from units located in other hospitals. Clustered data violate the assumption that all observations are independent since the average correlation of scores obtained within units from the same hospital will be higher than the average correlation of scores obtained among units located in different hospitals. For this reason, estimates of the standard error in regression coefficients can be inaccurate and result in spurious "significant" results (Wooldridge, 2000).

Model building and testing for length of stay as the dependent variable. When data are measured as continuous variables, mixed and random effects models can be used to account for the effect of clustering and, thus, correct for the violation of the independence assumption. Specifically, clustering by hospital is treated as a random effect which allows a separate intercept for each hospital thus controlling for the unobserved effect of hospital membership on scores obtained from nursing units in that hospital (Sashegyi, Stephen-

Brown, & Farrell, 2000). Therefore, a mixed models with hospital membership specified as a random effect was used to analyze data on length of stay as the dependent variable.

Ordinary least square (OLS) is the most commonly used approach to regression analysis. In OLS regression, the sum of the squared residuals that have the least value to the regression line is identified. Specifically, residuals are the difference between an observed and predictive value as generated by the regression model (Schroeder, Sjoquist, & Stephan, 1991; Singer, 1998). Although mixed models are similar to OLS, mixed modeling differs by allowing each cluster (hospital) to have its own intercept and/or slope, thus accounting for data clustering. In this analysis, unit tenure was excluded as a control variable because no literature was found to suggest a relationship between unit tenure and length of stay.

Model building and testing for severe medication errors as the dependent variable. Two statistical methods are recommended to account for clustering when data are measured as a count variable: generalized estimate equation (GEE) and non-linear mixed (NLM) models. GEE addresses the effect of clustering by creating a linear prediction inside a link function that handles correlated data (Jiang, 2007; Zeger & Liang, 1986). GEE is performed in SAS using the "GENMOD" procedure which is a marginal method that does not incorporate random effects but uses a procedure estimation that relies on R-side covariances only, with unknown parameters in R estimated using the method of moments (Littell, Milliken, Stroup, & Wolfinger, 1996). NLM, on the other hand, adapts Gaussian quadrature to compare several likelihood approximations which can advocate for random effects. NLM is performed in SAS using the "NlIMIXED" procedure. Although GEE and NLM can be equally effective when analyzing two-level clustered data, the "GENMOD" procedure cannot address the random effect of clustering with zero-inflated data. Therefore, NLM using the SAS "NlIMIXED" procedure was used to analyze data on severe medication errors as the dependent variable.

Poisson regression is recommended when the dependent variable is measured using count data (Liu & Cela, 2008). However, count data often exhibit over-dispersion or excessive zero values which is inconsistent with the restrictive assumption in Poisson regression of equi-dispersion. When data are characterized by over-dispersion, as was the case with severe medication errors, Poisson regression has been extended to include other models that have the potential to deal with over-dispersion, including the negative binomial, zero-inflated Poisson, and zero-inflated negative binomial models. In the following section, these models will be discussed.

The distribution of the *Poisson model* has the form of

$$\Pr(Y|\ \lambda) = \exp(-\lambda)\ \lambda^{y} / y_{!,}$$

where $P(Y|\ \lambda)$ is the probability of the event rate and Y equals λ. λ, in which the population mean and variance are equal to the mean. In other word, the Poisson density function depends on the mean number of events when the event rate is constant. Because the event rate is usually not constant, individual or group heterogeneity, contagious effects, or spells can result (Eaton, 1978; Long, 1997). If event rates depend on individual characteristics, then the Poisson model can be modified to let the mean, λ, be a function of individual characteristics, Xi. The form of the Poisson distribution then is modified as follows:

$$\lambda_i = \exp(X_i\beta)$$

$$\Pr(y_i|\ \lambda_i) = \exp(-\lambda_i)\ \lambda_i^{yi} / y_i\ !$$

This form assumes that the expected mean (λ) and variance for each case are the same as the overall mean (Bonate, Sung, Welch, & Richards, 2009; Hedeker & Gibbons 2006 ;

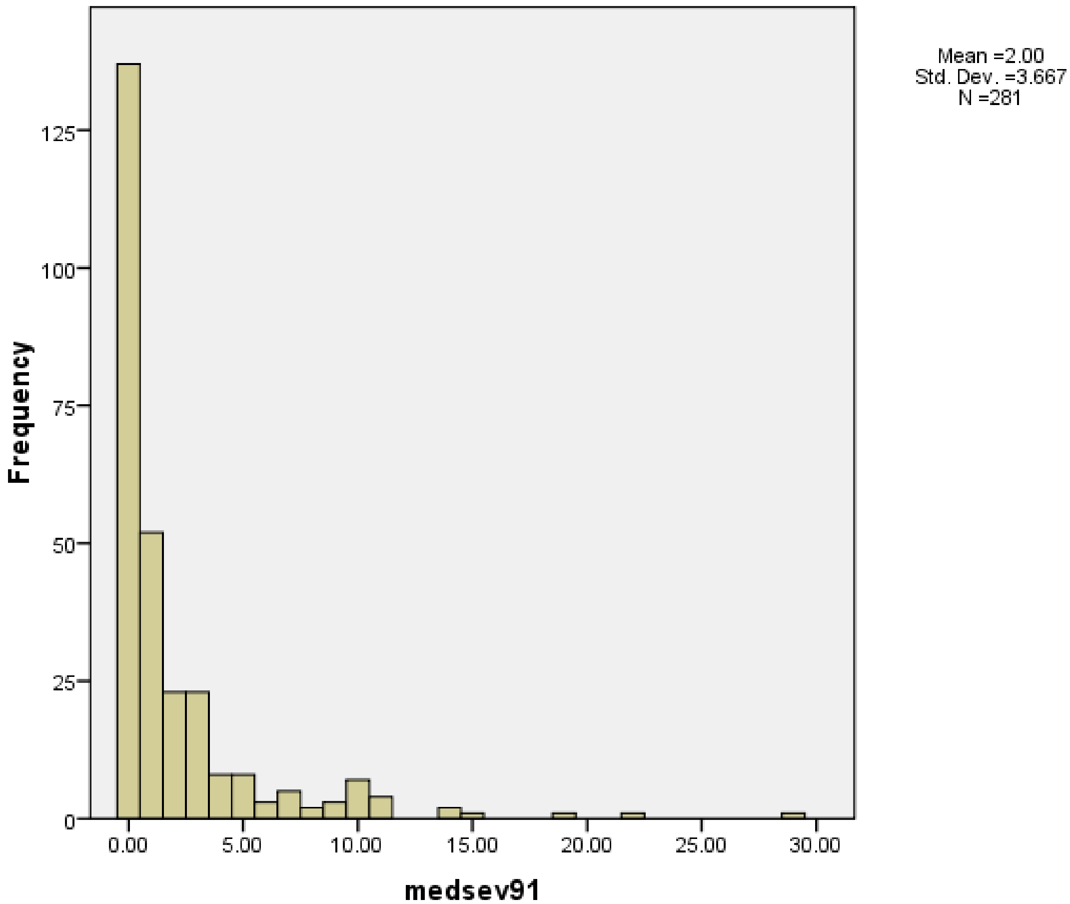

*Figure 7.*Distribution of values for severe medication errors

Winkelmann, 2008). This approach to Poisson regression can be successfully used only when X_i includes all relevant predictors that cause over-dispersion (Agresti, 2002; Tin, 2008). Specifically, the SAS procedures "COUTREG" and "NLMIXED" estimate dispersion. These procedures account for over-dispersion based on $Var(\lambda_i) = k_{\lambda i,}$ when $k \neq 0$, the estimation of $k > 1$, where k is the number of relevant predictors (Bonate et al.,2009, Tin, 2008).

It is difficult to identify all relevant predictor that may cause over-dispersion. Therefore, the *negative binomial model* can be used as an extension of the Poisson model when dispersion is the result of multiple potentially unobserved predictors ($k > 1$). Negative binomial models account for unobserved random variables which are the expected number of events: λ_i added to e_i (unobserved random variables).

$$\lambda_i=\exp(X_i\beta+e_i)$$

Negative binomial regression is based on the assumption that $\exp(e_i)$ has a gamma distribution with an expected value of 1 and a shape parameter of $1/k$, where $k > 0$, and $Pr(y_i \mid x_i)$ (Tin, 2008). The form of the negative binomial distribution can be written as:

$$Pr(y_i \mid \lambda_i) = \Gamma(y_i+1/k)(k\lambda_i)^{yi} / y_i!\Gamma(1/k)(1+k\lambda)^{yi+1/k}$$

The expected value of the mean (λi) does not change when either a Poisson or negative binomial distribution is assumed, because $E(\exp(e_i)) = 1$ and $E(\lambda_i) = E(\exp(X_i\beta+e_i) = E(\exp(X_i\beta)$. However, the variance of the Poisson model and negative binomial distributions differ because $k > 0$ and $Var(y_i \mid \lambda_i) = \lambda_i(1+k\lambda_i) > \lambda_i$. Therefore, the negative binomial model assume that variance is greater than the mean.

No criterion has been established for the percentage of zero values that is considered excessive. Although excessive zero values can be accommodated by increasing the variance function using negative binominal Poisson, zero-inflated Poisson is recommended when the distribution of scores has a high percentage of zero values (Hedeker & Gibbons 2006; Winkelmann, 2008).

The zero-inflated model can be viewed as a mixture of two statistical processes. One of these processes generates zero counts and the other generates both zero and non-zero counts (Stokes, Davis, & Koch, 2001). More specifically, a Logit process is used in zero-inflated models (e.g. zero-inflated Poisson or zero-inflated negative binomial) to generate only zero counts (see equation 1) and then a separate process is used to generate both zero and non-zero counts (e.g. Poisson, or negative binomial) (see equation 2). The simple form of the zero-inflated model can be written as:

$$\Pr (y_i | x_i, z_i) = P_i + (1-P_i)\, g(\lambda_i), \text{ if } y_i=0 \text{ (equation 1)}$$

$$\Pr (y_i | x_i, z_i) = (1-P_i)\, f(\lambda_i), \text{ if } y_i>0 \text{ (equation 2)}$$

The expected value for zero-inflated Poisson or negative binomial can be written as:

$$\Pr (y_i | x_i, z_i) = \lambda_i - \lambda_i P_i$$

These two processes are estimated by a probability, p, which depends on a set of predictors, z_i, that may be different from the count data model. Specifically, P_i is the probability when y_i =0, resulting in g (λ_i) as the density function with y_i =0 (binomial distribution) and f(λ_i) as the density function when y_i>0 (Poisson or negative binomial distribution). For this reason, the *zero-inflated Poisson model* can be written as:

$$\Pr (y_i | x_i, z_i) = P_i + (1-P_i) \exp(-\lambda_i), \text{ if } y_i=0$$

$$\Pr (y_i | x_i, z_i) = (1-P_i) \exp(-\lambda_i)\, \lambda_i^{y_i} / y_i\,!, \text{ if } y_i>0$$

The variance of the zero-inflated Poisson model can be written as:

$$\mathrm{Var} (y_i | x_i, z_i) = \lambda_i (1- P_i)(1+ \lambda_i P_i)$$

Zero-inflated negative binomial model is a form of the zero-inflated model that accounts not only for excessive zero values but also for over-dispersion. For this reason, it is a combination of the two processes that were described previously (Dobbie & Welsh, 2001a; 2001b; Lee, Wang, Scott, Yau, & McLachlan, 2006; Hedeker & Gibbons, 2006). The specific form of the zero-inflated negative binomial model can be written as:

$$\Pr(y_i | x_i, Z_i) = P_i + (1-P_i)\exp(-\lambda_i), \text{ if } y_i=0$$

$$\Pr(y_i | x_i, Z_i) = (1-P_i)\, \Gamma(y_i+1/k)(k\lambda_i)^{yi} / y_i!\Gamma(1/k)\, (1+k\lambda)^{\,yi+1/k}$$

The variance of the zero-inflated negative binomial model can be written as:

$$\mathrm{Var}(y_i | x_i, z_i) = \lambda_i(1- P_i)[1+ \lambda i(Pi+k)]$$

Severe medication errors were analyzed using a two-step approach to model selection. First, the random effect was ignored and the SAS procedure “COUTREG” was performed to compare the Poisson, negative binomial, zero-inflated Poisson, and zero-inflated negative binomial models. In the second step, the random effect was included and the SAS procedure “NLMIXED” was performed to compare these models for goodness of fit. Goodness of fit indices then were used to identify the best model for the analysis of the severe medication errors data.

Chapter Summary

In this chapter, the methodology used to test the research model and contingency hypotheses proposed in this study were described. An overview of ORNA-II as the parent study for this dissertation was presented. The sample along with the definition, measurement, and reliability of the variables included in this study were described. This chapter concluded with a presentation of the data aggregation and clustering issues that are associated with the ORNA-II data. Finally, the plan for statistical analysis of the research model and tests of the contingency hypotheses developed for this study were presented. Specifically, a mixed model was used to analyze data for length of stay as the dependent variable and comparison of four types of count models was done to identify the statistical approach that would be best for analyzing the data for severe medication errors.

CHAPTER 5

STUDY RESULTS

The purpose of this study was to describe relationships among organizational context (characteristics of the environment and technology) and structure (relational coordination) fit and organizational effectiveness (length of stay and severe medication errors) on medical-surgical nursing units. In this chapter, results from the analyses of models to separately test the relationships among contextual-structure fit and patients' length of stay and severe medication errors are reported. This chapter begins with a description of the variables that were included in the research models for this study. Following this description, the major study findings are presented. This discussion will start with an evaluation of these data in terms of the assumptions of the underlying statistical procedures that were used and conclude with the results related to the hypotheses as stated in Chapter 3.

Description of Study Variables

Major Study Variables

Table 11 summarized the descriptive statistics for the major study variables. Units in this study were moderately large with an average of 34 beds. Workload was somewhat higher than the national average of 5 patients to 1 nurse (Altman et al., 2005), with an average for these units of 5.27 patients per nurse with scores clustered around 3.6 to 6.94. In general, support service availability was rated as medium to high as was work complexity. Nurses on these units rated patient acuity as medium to low with only some to about one-half of patients identified as needing frequent and more technologically complex patient care.

Table 11

Descriptive Statistics for Study Variables

Study Variables	Mean	SD	Minimum	Maximum
Major Study Variables				
Unit Size	33.53	11.16	13.00	80.00
Workload	5.27	1.67	2.26	12.00
Support Services Availability	32.36	2.49	23.00	39.17
Patient Acuity	45.57	3.59	34.50	56.67
Work Complexity	26.84	3.50	15.79	37.40
Relational Coordination	226.06	12.67	157.50	262.80
Relational Coordination	51.12	3.52	34.00	59.67
Nurse-Physicians & Nurse Pharmacist				
Length of Stay	4.55	1.09	2.23	9.22
Severe Medication Errors	2.00	3.67	0.00	29.00
Control Variables				
Hospital Size	345.84	185.22	75.00	1242.00
Teaching Status	0.13	0.25	< 0.01	1.23
Case Mix Index	1.44	0.32	0.89	3.67
RN Experience	138.49	45.38	43.57	322.80
Unit Tenure	74.77	33.05	9.00	199.89
Educational Preparation	36.52	19.36	< 0.01	100.00
RN Skill Mix	59.42	13.43	23.26	100.00

The quality of relational coordination among all healthcare providers was rated as medium to high on most units. Similarly, the quality of relational coordination among nurses, physicians, and pharmacists was also rated as medium to high. The average length of stay on these units was 4.55 (SD = 1.09) with a range from 2.32 to 9.22 per 1000 patient days. On average, two medication errors (SD = 3.6) were reported on these units during the final three month data collection period of the ORNA-II study. Despite this low number, however, the frequency of medication errors during these three months was widely dispersed, with medication errors ranging from 0 to 29.

Control Variables

Based on the review of literature, the decision was made to control for three hospital- and four unit-level variables during model testing. At the hospital level, the potential effect of hospital size, teaching status, case mix index were controlled. At the nursing unit level, the potential effect of three RN workgroup characteristics were controlled including average nursing experience, average unit tenure, and percentage of the RN workgroup with a baccalaureate degree in nursing or higher. In addition, the potential effect of skill mix in terms of the composition of the nursing workgroup on each unit was controlled. A summary of the descriptive statistics for the control variables are provided in Table 11.

Multicollinearity Among Study Variables

Multicollinearity can be defined as the presence of two or more independent variables that are strongly, but not perfectly, correlated (Berry & Feldman, 1985; Fox, 1991). Although multicollinearity does not violate the assumptions of regression, its presence tends to inflate standard errors of the regression coefficients. In other word, the result of the regression analysis may be biased when variables in the model are strongly correlated

Table 12

Bivariate Correlations Among Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Major Study Variables																
1. Unit size	1.00															
2. Workload	0.13	1.00														
3. Support Services	0.04	-0.16	1.00													
4. Patient Acuity	< 0.01	0.02	-0.11	1.00												
5. Work Complexity	0.23**	0.16	-0.23**	0.17*	1.00											
6. Rel Coord	-0.05	-0.06	0.29**	0.04	-0.32**	1.00										
7. Rel Coord (MD/PH)	-0.10	-0.08	0.26**	-0.02	-0.33**	0.83**	1.00									
8. Length of Stay	-0.11*	0.09	-0.09	0.21**	-0.13	0.09	0.01	1.00								
9. Medication Errors	0.15**	-0.07	0.05	-0.05	-0.03	0.07	0.08	0.06	1.00							
Control Variables																
10. Hospital Size	0.07	0.03	0.14	0.07	0.04	-0.06	-0.11	0.22**	-0.02	1.00						
11. Teaching Status	-0.08	0.17*	-0.12	0.03	0.03	-0.17*	-0.31**	0.01	-0.09	0.33*	1.00					
12. Case Mix Index	-0.03	0.23*	-0.12	0.04	0.09	0.04	0.03	-0.03	0.01	0.38**	0.24**	1.00				
13. RN Experience	0.11	< -0.01	-0.07	-0.09	-0.05	-0.04	0.03	-0.08	0.04	-0.05	0.02	-0.01	1.00			
14. Unit Tenure	0.04	-0.07	.07	-0.11	-0.18*	0.09	0.16	-0.07	0.09	-0.05	-0.03	0.07	0.62**	1.00		
15. RN Education	0.01	-0.17*	-0.08	0.12	0.06	0.02	-0.11	0.07	-0.14	0.26**	0.30**	0.26**	-0.05	-0.04	1.00	
16. RN Skill Mix	-0.09	-0.56**	0.13	-0.02	-0.20*	0.09	0.10	-0.02	0.04	0.23**	0.26**	0.14	0.03	0.05	0.20**	1.00

Note. Significance levels have been adjusted to account for clustering of units inside the same hospital for correlations involving length of stay (by LMM) and medication errors (by random effect negative binomial models). For all other correlations the degrees of freedom were adjusted: *p < 0.05; **p < 0.01.

Table 13

Evaluation of Data for Multicollinearity

Study Variables	**Length of Stay**		**Medication Errors**	
	Tolerance	VIF	Tolerance	VIF
Major Study Variables				
Unit size	0.88	1.13	0.88	1.13
Workload	0.64	1.57	0.63	1.57
Support Services Availability	0.80	1.24	0.82	1.22
Patient Acuity	0.93	1.08	0.94	1.06
Work Complexity	0.76	1.31	0.76	1.31
Relational Coordination	0.80	1.25		
Relational Coordination MD/PH			0.75	1.34
Control Variables				
Hospital Size	0.74	1.35	0.75	1.34
Teaching Status	0.74	1.35	0.69	1.44
Case Mix Index	0.77	1.3	0.77	1.30
RN experience	0.57	1.75	0.58	1.72
Unit Tenure	0.56	1.77	0.81	1.24
Educational Preparation	0.81	1.22	0.81	1.24
Skill mix	0.61	1.65	0.60	1.67

(Bahn & Massenburg, 2008; Schroeder, Sjoquist, & Stephan, 1991). There are several ways to evaluate for the presence of multicollinearity. First, the magnitude of the zero-order correlations in a bivariate correlation matrix can be examined. Correlations that exceed 0.80 indicate a high potential for multicollinearity (Bahn & Massenburg, 2008; Berry, 1993). In Table 12, bivariate correlations among the study variables are reported. Although some correlations were statistically significant, none exceeded the value of 0.80, suggesting that prima facie evidence of multicollinearity was not present in these data. Second, multicollinearity can be evaluated by inspecting the values for the variance inflation factor (VIF), defined as $1/(1-R^2)$, and tolerance, defined as $1-R^2$. VIF values are one when there is no multicollinearity and increase as multicollinearity increases. Tolerance values of one indicate no multicollinearity and decrease in the presence of multicollinearity. Table 13 summarizes the results of the regression analyzes that were used to calculate VIF and tolerance. VIF values ranged from 1.13 to 1.67 and tolerance values ranged from 0.61 to 0.93, suggesting limited multicollinearity among the study variables.

Analysis Using Length of Stay as the Dependent Variable

Random-effects mixed models were used to describe the relationships among context-structure fit and length of stay. Evaluation of model fit will be discussed prior to reporting the results of hypothesis testing. As reported in Chapter 4, unit tenure was excluded as a control variable in this analysis because no literature was found to suggest a relationship between unit tenure and length of stay.

Model Fit

Model fit was examined with various residuals plots. Plots for the main model in

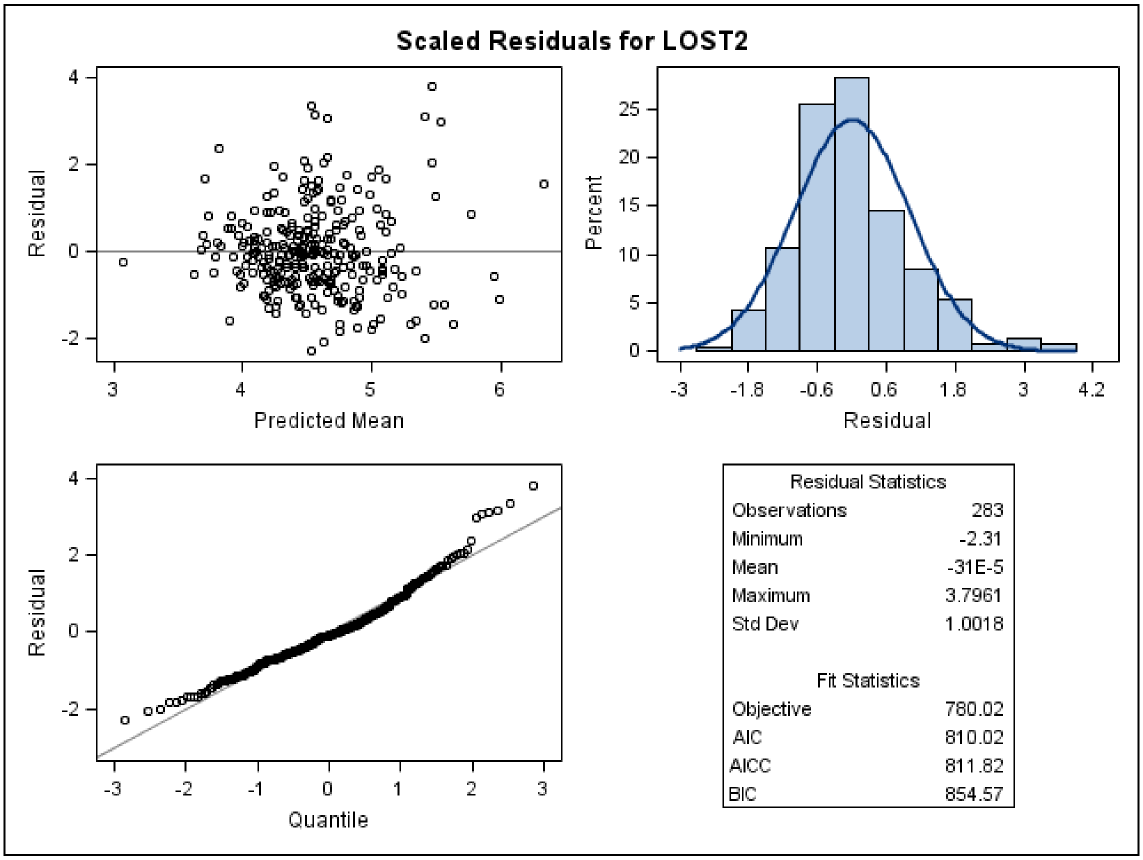

Figure 8. Score distribution and residual plots for length of stay in the main model

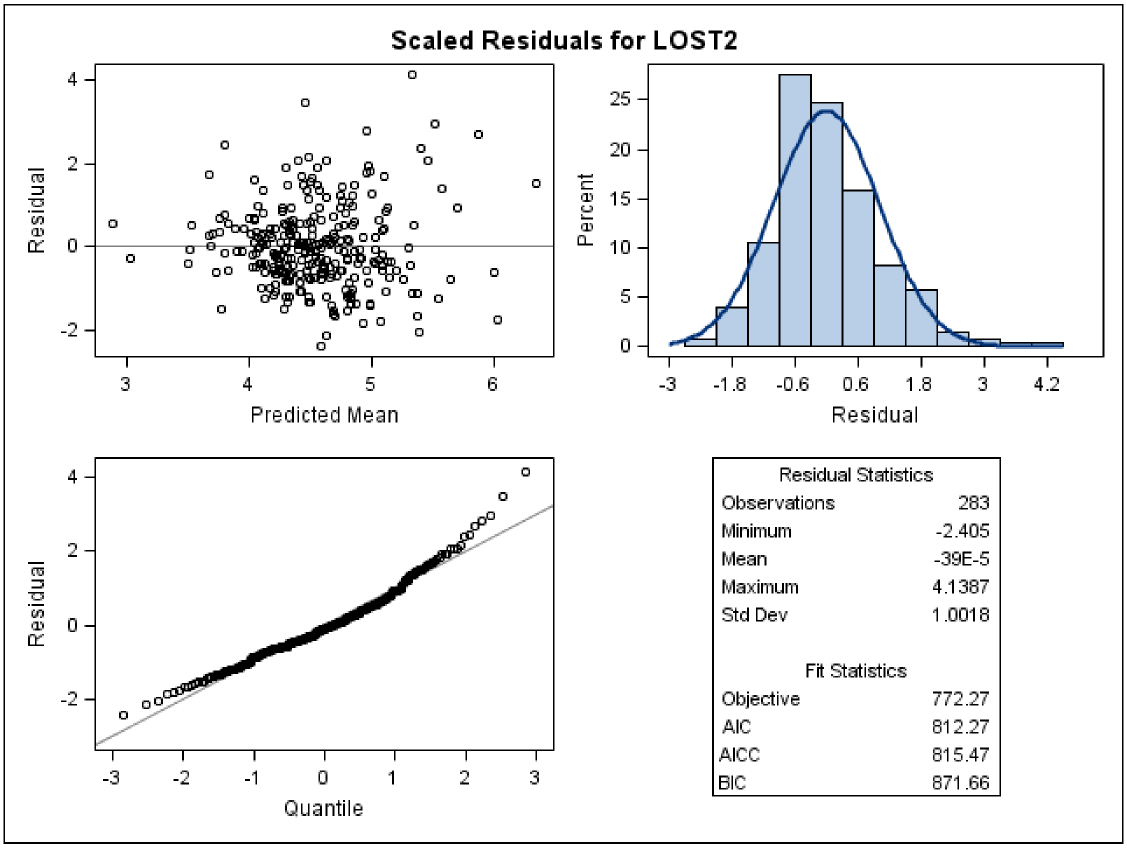

Figure 9. Score distribution and residual plots for length of stay in the interaction model

which the interaction terms for contextual-structural fit were excluded are shown in Figure 8. Plots for the final model in which interaction terms were included are shown in Figure 9. In both figures, the residual histogram with overlaid normal density are graphically displayed in the upper right corner. Values for Akaike's information criterion (AIC), the Bayesian information criterion (BIC), and the finite-population corrected AIC (AICC) are reported in the lower right corner. The information in these figures suggests that these data approximated a normal distribution, met the distributional assumptions of mixed models, and were appropriately matched to the chosen variance function. According to Littell, Milliken, Stroup, Wolfinger, and Schabenberger (2006), smaller values for the AIC, BIC, and AICC are indicative of a better fitting model. As shown in Figures 8 and 9, smaller values for these indices were found for the main model, suggesting that this model provided a better fit to the data than did the interaction model. However, the log likelihood ratio test indicated that the main and interaction models did not significantly differ (df = 5, chi-square= 7.9, p = 0.16).

Hypothesis Testing

Results from the analysis of the random-effects mixed models for length of stay as the dependent variable are reported in Table 14. Results from the analysis of the main model were used to address the first hypothesis. Results from the analysis of the interaction model were used to answer all remaining hypotheses. In this analysis, the value for relational coordination was based on the sum of the ratings for quality of relational coordination between nurses and nine other healthcare providers.

Hypothesis 1. Hypothesis 1 stated that nursing units with higher quality relational coordination would be associated with shorter lengths of stay. Results from the

Table 14

Analysis of Mixed Models for Length of Stay

	Main Model		**Interaction Model**	
	Estimate	**SE**	**Estimate**	**SE**
Intercept	2.98	1.76	17.49	22.91
Unit Size	-0.01**	0.01	0.07	0.10
Workload	0.07	0.05	-1.49**	0.71
Support Service Availability	-0.02	0.03	-0.41	0.45
Patient Acuity	0.06**	0.02	0.29	0.26
Work Complexity	-0.04*	0.02	-0.31	0.28
Relational Coordination	< 0.01	0.01	-0.07	0.10
Unit Size*Relational Coordination			< -0.01	< 0.01
Support*Relational Coordination			< 0.01	< 0.01
Workload* Relational Coordination			0.01**	< 0.01
Complexity*Relational Coordination			< 0.01	< 0.01
Acuity*Relational Coordination			-0.00	< 0.01
Control Variables				
Hospital Size	< 0.01*	< 0.01	< 0.01***	< 0.01
CMI	-0.44	0.24	-0.44	0.24
Teaching Status	-0.31	0.31	-0.29	0.30
RN Experience	< -0.01	< 0.01	-0.01	< 0.01
RN Educational Preparation	0.01	0.34	0.01	0.34
RN Skill Mix	< -0.01	0.01	-0.01	0.01

*p < 0.06; **p < 0.05; ***p < 0.01

analysis of the main model indicated that relational coordination was positively associated with length of stay, meaning that length of stay was longer on units with better quality relational coordination. Hypothesis 1 was not supported because the regression coefficient was not statistically significant and the direction of the relationship differed from that hypothesized.

Hypothesis 3A. Hypothesis 3A stated that as unit size increased, higher quality relational coordination would be more strongly associated with lower lengths of stay. Results from the analysis of the main model indicated that unit size was significantly and inversely related to length of stay, meaning that larger units were associated with shorter lengths of stay. In contrast, higher quality relational coordination was positively associated with length of stay in the main model, meaning that units with higher quality relational coordination were associated with longer lengths of stay. This relationship, however, was not statistically significant.

Analysis of the interaction model, however, yielded different results. In this model, the relationships between unit size and length of stay and relational coordination and length of stay were not significant but the direction of these relationships was revered. Therefore, as unit size increased, length of stay also increased. In contrast, higher quality relational coordination was associated with shorter rather than longer lengths of stay. The unit size*relational coordination interaction term had a negative but statistically insignificant parameter estimate. Although this finding was not statistically significant, the interaction effect is consistent with that hypothesized. In other words, as unit size increased, higher quality relational coordination was more strongly associated with lower lengths of stay.

Hypothesis 4A. This hypothesis stated that as unit workload increased, higher quality relational coordination would be more strongly associated with lower lengths of stay. As stated previously, higher quality relational coordination was positively but insignificantly associated with length of stay in the main model. Workload also was positively associated with length of stay, meaning that as workload increased, length of stay increased. However, the parameter estimate for the relationship between workload and length of stay was not statistically significant.

As previously discussed, the direction of the relationship between relational coordination and length of stay changed from positive to negative in the interaction model. Similarly, the direction of the relationship between workload and length of stay also changed from positive to negative in the interaction model and was statistically significant. These finding suggest that as workload increased, length of stay decreased rather than increased. The workload*relational coordination interaction term, however, had a significantly positive parameter estimate. The marginal effect of workload on the relational coordination and length of stay relationship is diagrammed in Figure 10. As shown in this figure, as workload increased, higher quality relational coordination was associated with longer lengths of stay. Because an inverse relationship between fit of workload with relational coordination and patients' length of stay was hypothesized, hypothesis 4A was not supported.

Hypothesis 5A. This hypothesis stated that as the availability of support services increased, higher quality relational coordination would be more strongly associated with lower lengths of stay. As stated previously, higher quality relational coordination was positively but not significantly associated with length of stay in the main model and

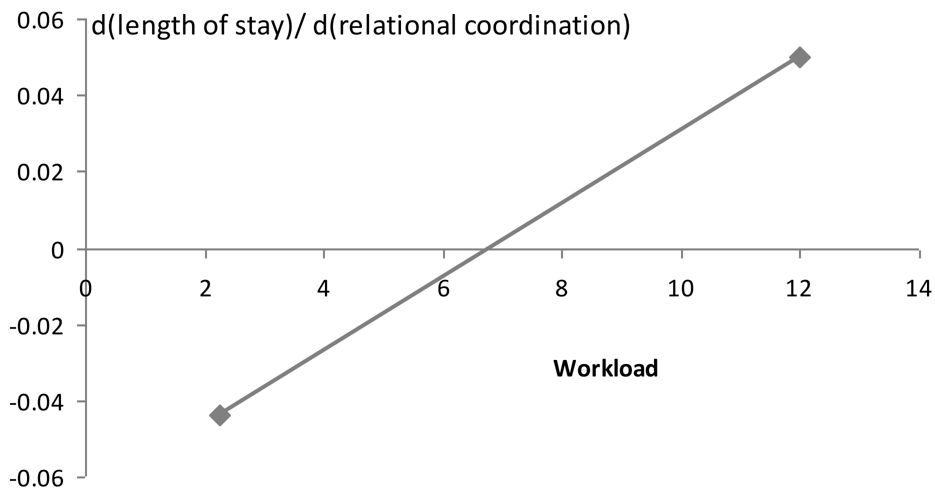

Figure 10. Effect of workload on the relationship between relational coordination and length of stay

negatively and insignificantly associated with length of stay in the interaction model. Results from both the main and interaction models indicated that shorter lengths of stay were reported on units with greater support services availability. However, these results were not significant. The effect of support services availability*relational coordination interaction was positive suggesting that as support services availability increased, higher quality relational coordination was associated with longer lengths of stay. This estimate was weak and not statistically significant ($\beta < .01$). Therefore, Hypothesis 5A was not supported.

Hypothesis 6A. It was hypothesized that as patient acuity increased, higher quality relational coordination would be more strongly associated with lower lengths of stay. Higher quality relational coordination was positively but insignificantly associated with length of stay in the main model and negatively and insignificantly associated with length of stay in the interaction model. Results from both the main and interaction models indicated that units with higher patient acuity reported longer lengths of stay. Although this relationship approached statistical significance for the main model, it was not significant in the interaction model. The patient acuity*relational coordination interaction term was negatively associated with length of stay ($\beta < -.01$), meaning that the fit between higher patient acuity and higher quality relational coordination was associated with shorter lengths of stay. Although this result was consistent with SCT and the proposed hypothesis, the parameter estimate was weak and statistically insignificant. Therefore, hypothesis 6A was not supported.

Hypothesis 7A. It was hypothesized that as work complexity increased, higher quality relational coordination would be more strongly associated with lower lengths of stay. Higher quality relational coordination was positively but insignificantly associated with length of stay in the main model and negatively and insignificantly associated with length of stay in the interaction model. Although results for both the main and interaction models showed that greater work complexity was associated with shorter lengths of stay, the parameter estimate was significant in the main model only. The parameter estimate for the work complexity* relational coordination interaction term was positive, suggesting that as work complexity increased, high quality relational coordination was associated with longer lengths of stay. This estimate, however, was weak ($\beta < .01$) and not statistically significant so Hypothesis 7A was not supported.

Analysis Using Medication Errors as the Dependent Variable

Model Selection

The goal of model selection was to identify the appropriate model to analyze the data for severe medication errors, given that the distribution of scores was positively skewed and the data included a high percentage of zero values. Models using Poisson regression, negative binomial, zero-inflated binomial, and zero- inflated Poisson regression procedures were compared. As the first step in this selection process, hospital membership as the clustering variable was excluded and the "COUTREG" program in SAS was used to compare fit of the four models. In the second step of model selection, the random effect of hospital membership was included and SAS procedure called "NLMIXED" was used to select the best model for analyzing the data for severe medication errors.

The first step in model selection was based on two sources of information. First, values of the AIC, log likelihood, and Schwarz's Bayesian information criterion (SBC)

Table 15

Model Comparison for Severe Medication Errors

Models	No Random Effect			With Random Effect		
	Log likelihood	AIC	SBC	AIC	AICC	BIC
Poisson	-717.95	1464	1515	953.8	955.7	998.2
Zero-inflated Poisson	-562.62	1155	1210	952.9	955	1000.2
Negative Binomial	-484.91	999.8	1054	949.5	951.3	993.8
Zero-inflated Negative Binomial	-484.84	1002	1060	950.2	952.8	1003.4

were examined to compare model fit. As shown in Table 15, the negative binomial model had the smallest values for the AIC and SBC, suggesting that it was the best approach for analysis of these data. Second, the presence of over-dispersion and zero-inflation for severe medication errors was examined. Negative binomial, zero-inflated negative binomial, and zero-inflated Poisson models include dispersion parameters, which indicate the presence of over-dispersion and/or an inflated intercept and the presence of a zero-inflated distribution. Using the formula of -2(log likelihood of Poisson - log likelihood of negative binomial), the likelihood ratio test statistic, calculated as -2(-717.95 + 487.07) resulted in a value of 461.76, which was highly significant and strongly indicative of over-dispersion (Cameron & Trivedi, 1998). Similarly, the parameter estimate for over-dispersion in the zero-inflated negative binomial model also was statistically significant and indicated over-dispersion (parameter estimate = 1.79, SE = 0.85, $p < 0.03$). The inflated intercept parameter estimate for the negative binomial model also was highly significant (parameter estimate = 2.11, SE = 0.13, $p < 0.0001$) but insignificant for the zero-inflated negative binomial model (parameter estimate = -2.42, SE = 2.69, $p = 0.37$) and the zero-inflated Poisson model (parameter estimate = -0.21, SE = 0=0.13, $p = 0.11$). These results suggested the presence of over-dispersion but not zero inflation. These results provided additional support for the negative binomial model as the best approach for analysis of these data.

In the second step of model selection, hospital membership was included as a random effect. In this step, information about over-dispersion and zero inflation were unavailable so identification of the best model was based on values of the AIC, AICC and BIC. As shown in Table 14, the smallest values for these goodness of fit estimates were found for the negative binomial model, suggesting that it was the best approach for analysis of these data.

In addition, the random effect of hospital membership was significant in all models ($p < .0001$), supporting the decision to control for the effect of clustering. Consequently, the decision was made to analyze the data for severe medication errors using a random effects negative binomial model.

In summary, the two-step process used for model selection suggested that the effect of hospital membership could not be ignored and the negative binomial regression model was the most appropriate approach for the analysis of the severe medication errors data. Similar to the mixed models for length of stay, a main model with interaction terms excluded and an interaction model with interactions terms included were tested. Using fit indices similar to those used for the mixed models, comparison of the models for severe medication errors suggested that the main model (AIC = 949.5, AICC = 951.3, BIC = 993.8) provided a better fit to the data than did the interaction model (AIC = 956.3, AICC = 959.6, BIC = 1015.4). However, the log likelihood ratio test indicated that the main and interaction models did not significantly differ (df = 5, chi-square = 2.7, p = 0.7).

The following section describes the findings from the analysis of the random effect negative binomial model to test Hypotheses 2 and 3B through 7B. Results based on the analysis of the main model which excluded interaction terms are presented first followed by results from the analysis of the interaction model. In this analysis, the value for relational coordination was based on the sum of the ratings for nurses and physicians and nurses and pharmacists. Findings from the analysis of the random effect negative binomial model are displayed in Table 16.

Hypothesis Testing

Table 16

Results of Model Testing for Severe Medication Errors

Variables	Estimate	SE	Estimate	SE
Intercept	6.27**	2.70	0.06	29.78
Unit Size	-0.04**	0.01	0.03	0.14
Workload	0.04	0.07	0.37	0.93
Support Service Availability	0.04	0.04	0.69	0.58
Work Complexity	0.02	0.03	0.09	0.30
Patient Acuity	-0.02	0.02	-0.46	0.37
RelcoordMDPH	-0.05	0.03	0.06	0.58
Unit Size* RelcoordMDPH			< -0.01	< 0.01
Support* RelcoordMDPH			< -0.01	< 0.01
Workload* RelcoordMDPH			-0.01	0.02
Complexity* RelcoordMDPH			< -0.01	0.01
Acuity* RelcoordMDPH			0.01	0.01
Hospital Size	< 0.01	< 0.01	< 0.01	< 0.01
CMI	-0.68	0.51	-0.68	0.52
Teaching Status	.32	0.67	0.32	.68
RN Experience	< 0.01	< 0.01	< 0.01	< 0.01
Unit Tenure	< 0.01	< 0.01	< 0.01	< 0.01
RN Educational Preparation	0.22	0.51	0.49	0.54
RN Skill Mix	< 0.01	0.01	0.01	0.01
S2u	2.24***	0.46	2.26***	0.47

Note. S2u= estimate of the variance of the random effect

**p < 0.05; ***p < 0.01

Hypothesis 2. This hypothesis stated that nursing units with higher quality relational coordination between nurses and physicians and nurses and pharmacists would be associated with fewer severe medication errors. This hypothesis was tested using results from the main model only. Relational coordination was negatively associated with the number of severe medication errors. In other words, nursing units with higher quality relational coordination had fewer severe medication errors. Although the direction of the relationship was consistent with that hypothesized, the parameter estimate was not statistically significant so Hypothesis 2 was not supported.

Hypothesis 3B. It was hypothesized that as unit size increased, higher quality relational coordination would be more strongly associated with fewer severe medication errors. Results from the analysis of the main model indicated that relational coordination was inversely but insignificantly associated with the number of severe medication errors. In the interaction model, relational coordination was positively but not significantly associated with the number of medication errors. Unit size was inversely and significantly associated with the number of severe medication errors in the main model, meaning that larger units reported fewer medication errors. In the interaction model, however, unit size was positively but not significantly associated with the number of severe medication errors. In other words, larger units were associated with more medication errors. The unit size*relational coordination interaction was negatively associated with severe medication errors, suggesting that as unit size increased, higher quality relational coordination was associated with fewer severe medication errors. Although the direction of this relationship was consistent with that hypothesized, the parameter estimate was insignificant. Therefore, Hypothesis 3B was not supported.

Hypothesis 4B. It was hypothesized that as workload increased, higher quality relational coordination would be more strongly associated with fewer medication errors. Results from the analysis of the main model indicated that relational coordination was inversely but insignificantly associated with number of severe medication errors. In the interaction model, relational coordination was positively but not significantly associated with the number of medication errors. Workload in both the main and interaction models was positively but not significantly associated with the number of severe medication errors, meaning that as workload increased, the number of severe medication errors also increased. However, a negative parameter estimate was found for the workload*relational coordination interaction term ($\beta = -0.01$, $p = 0.27$), suggesting that, as workload increased, higher quality relational coordination was associated with fewer medication errors. Although Hypothesis 4B was not supported because the results were insignificant, the direction of the relationship for fit of workload and relational coordination with severe medication errors was consistent with SCT.

Hypothesis 5B. It was hypothesized that as availability of support services increased, higher quality relational coordination would be more strongly associated with fewer medication errors. Results from the analysis of the main model indicated that relational coordination was inversely but insignificantly associated with number of severe medication errors. In the interaction model, relational coordination was positively but not significantly associated with the number of medication errors. Greater availability of support services was associated with more severe medication errors in both the main and interaction models. The parameter estimate for support services availability*relational coordination was negative and not significant ($\beta = -0.01$, $p = 0.27$). Although the direction of the relationship between fit and severe medication errors was consistent with SCT, Hypotheses 5B was not supported.

Hypothesis 6B. It was hypothesized that as patient acuity increased, higher quality relational coordination would be more strongly associated with fewer medication errors. Results from the analysis of the main model indicated that relational coordination was inversely but insignificantly associated with number of severe medication errors. In the interaction model, relational coordination was positively but not significantly associated with the number of medication errors. In both the main and interaction models, higher patient acuity was associated with fewer severe medication errors. The parameter estimates for these models were not statistically significant. Similarly, a negative parameter estimate was found for patient acuity*relational coordination, suggesting that as patient acuity increased, higher quality relational coordination was associated with fewer rather than more severe medication errors. Although the direction of this relationship was consistent with that hypothesized, the parameter estimate was not statistically significant. Therefore, Hypothesis 6B was not supported.

Hypothesis 7B. It was hypothesized that as work complexity increased, higher quality relational coordination would be more strongly associated with fewer medication errors. Results from the analysis of the main model indicated that relational coordination was inversely but insignificantly associated with number of severe medication errors. In the interaction model, relational coordination was positively but not significantly associated with the number of medication errors. Although greater work complexity was associated with more severe medication errors in both the main and interaction models, the parameter estimates were not significant. In contrast, a negative parameter estimate was found for the work complexity*relational coordination term. The direction of this relationship was consistent with that hypothesized, meaning that as work complexity increased, higher quality relational coordination was associated with fewer severe medication errors. However, Hypothesis 7B was not supported because the effect was weak and not statistically significant.

Chapter Summary

In this chapter, findings were reported from the analysis of separate models in which length of stay and severe medication errors were specified as the dependent variables. Mixed models with hospital membership specified as a random effect were used to test the hypotheses for length of stay. In this analysis, only the interaction term for workload and relational coordination was statistically significant. Contrary to the hypothesis, findings indicated that as workload increased, higher quality relational coordination was associated with longer rather than shorter lengths of stay. The negative binomial model, chosen using a two-step model selection process, was used to test the hypotheses for severe medication errors. None of these hypotheses were supported.

In Chapter 6, the findings from this study are summarized and discussed. In particular, these findings are placed within the context of prior research conducted to investigate organizational and unit-level factors that are associated with length of stay and severe medication errors. In addition, the theoretical implications of this study as a test of SCT are described. Following this discussion, study limitations and recommendations for future research are presented.

CHAPTER 6

DISCUSSION

The purpose of this study was to describe relationships between structure and effectiveness and among contextual and structural fit at the nursing unit level and unit level performance in terms of quality and efficiency. Specifically, relationships were tested among contextual (unit size, workload, support service availability, work complexity and patient acuity) and structural (relational coordination) fit at the nursing unit level and unit level effectiveness in terms of efficiency (length of patient stay) and quality (severe medication errors). First, a summary of findings from the models tested using length of stay and severe medication errors will be presented. The results for Hypothesis 1 and 2 will be discussed and compared to findings previously reported in the literature. Results for the remaining hypotheses then will be discussed along with possible explanations for these results. Comparison of these results to existing literature was not possible, however, since no studies were found in which fit hypotheses similar to those tested in this study were investigated. This chapter will conclude with a discussion of the limitations of this study and identification of areas for future research.

Summary of Key Findings

Two separate models were analyzed to test the hypothesized relationships among contextual-structure fit with length of stay and severe medication errors. The analysis of these models resulted in different findings. Model testing for length of stay as the dependent variable suggested that the interaction between context and structure provided a better fit to the data than did the main model in which interaction terms were excluded. In contrast, model testing for severe medication errors as the dependent variable suggested that the main model provided a better fit to the data that did the model that included interaction terms. In other word, the effect of contextual-structural fit on unit level effectiveness was more consistent with SCT fit hypotheses for length of stay than for severe medication errors.

Length of stay

An inverse relationship between relational coordination and length of stay was hypothesized. In both the main and interaction models, this hypothesis was not supported. Further, the direction of the relationship between relational coordination and length of stay differed in the main and interaction models. The relationship was positive in the main model, suggesting that better relational coordination was associated with longer lengths of stay, but negative in the interaction model, suggesting that better relational coordination was associated with shorter lengths of stay. This finding is similar to the work of other researchers who have been unable to document a consistent relationship between relational coordination or similar variables like teamwork or interprofessional collaboration and length of stay (Brewer, 2006; Gittell et al., 2000; Gittell, 2002; Pollack & Koch, 2003; Rubin et al., 2005; Tschannen & Kalisch, 2009a; Wild et al., 2004). Relational coordination was measured in this study using nurses' ratings for nine different healthcare groups. It is possible that including so many groups may have diluted the ratings for relational coordination between nurses and physicians and between nurses and pharmacists, providers with whom relational coordination is most likely to be relevant in terms of the outcomes measured in this study.

Unit size and *patient acuity* were the only contextual variables that were significantly associated with length of stay in the main model The relationships between these variables and length of stay, however, became insignificant in the interaction model. The inverse relationship between unit size and length of stay found in the main model is consistent with findings from a study by Ruttimann and Pollack (1996) who documented shorter lengths of stay among larger units. Yet, the positive relationship between unit size and length of stay found in the interaction model, though insignificant, is consistent with the findings by Clark and Normile (2002) who documented longer lengths of stay among larger units. Therefore, the relationship between unit size and length of stay remains unclear.

Similar to results reported in other studies, a statistically significant inverse relationship between patient acuity and length of stay was found in the analysis of the main model (Chant et al.2006; Crandall et al., 2009; Ritter-Teitel, 2004). In contrast, other studies have found no relationship between patient acuity and length of stay (Blank et al., 2005; Dowdy et al., 1998), findings that are consistent with the insignificant relationship found in the interaction model tested in this study. The findings from this study along with those reported in other studies suggest the need for further research to clarify the relationship between patient acuity and length of stay.

Workload was positively but not significantly associated with length of stay in the main model, meaning that as workload increased, length of stay was longer. In general, other researchers also have found that heavier workloads are associated with longer lengths of stay (Decker, 2008; Garretson, 2004; Ong et al., 2007; Padilha et al., 2008). In contrast, workload was significantly but inversely related to length of stay in the interaction model, with shorter lengths of stay documented on units with heavier workloads. This finding is similar to that of Garretson (2004) who found a positive relationship between workload and length of stay.

When the effect of the workload-relational coordination interaction term was controlled in the test of the interaction model, however, heavier workloads were significantly associated with shorter lengths of stay. The reason for this finding is unclear. Heavier workloads are assumed to reduce the time that nurses can spend in meeting patients' needs, thus increasing the likelihood that length of stay will be longer. However, nurses' workload can be affected by both patient and non-patient factors (Morris, MacNeela, Scott, Treacy, & Hyde, 2007). It is possible that, as nurses' workload increases, patients may be discharged more rapidly as a way to reduce staffing demands on the unit. On the other hand, it also is possible that shorter lengths of stay actually contribute to an increased workload because of the time and effort that are required to plan and implement patient discharges. As noted previously, these mixed findings along with those reported in other studies suggest the need for further research to clarify the relationship between workload and length of stay.

From the perspective of SCT, heavier workloads should increase information processing demands which can be addressed through better relational coordination. For this reason, it was hypothesized that, as workload increases, high quality relational coordination would be associated with greater effectiveness in terms of shorter lengths of stay. However, the interaction of workload and relational coordination was positively and significantly associated with length of stay. Therefore, this hypothesis was not supported. Specifically, as workload increased, higher quality relational coordination was associated with longer lengths of patient stay. It is possible that, despite heavier workloads, higher quality relational coordination contributes to meaningful interactions among healthcare providers that result in the decision to prolong length of stay when necessary due to patients' condition. In addition, illness severity on the unit also may contribute to the explanation of this finding. Several studies have found that, as illness severity increases, workload as well as length of stay also increase (Castillo-Lorente, River-Fernandez, Rodriguez-Elvira, &Vazquez-Mata, 2000; Kiekkas et al., 2007; Lefering et al., 1997; Yee Kwok, Chun Chau , Pau Le Low, & Thompson, 2005; Weissman et al., 2007).

It is possible that measurement issues may contribute to the explanation of these findings. Nurse to patient ratio was used to measure workload in this study. The mean value for workload in this study was 5.27 with a standard deviation of 1.67 and a range of scores between 2.26 to 12. Although the mean nurse to patient ratio in this study was comparable to the national average of 5 patients to 1 nurse, these data clustered around values that ranged from 3 to 7. Therefore, the units in this study were characterized by a light to moderately heavy workload. The limited difference between a light and a moderately heavy workload on these units may have contributed to the inconsistent results found in this study.

Although work complexity and patient acuity were included in the models tested in this study, these variables provided information about resource consumption in terms of the volume and types of services that were required to provide patient care rather than illness severity in terms of degree of physiologic decompensation. Measurement of these variables from a resource consumption perspective may have contributed to the lack of support for the hypotheses tested in this study.

Severe Medication Errors

It was hypothesized that higher quality relational coordination between nurses and physicians and nurses and pharmacists would be associated with fewer severe medication errors. Tests of the main and interaction models did not support this hypothesis, with an insignificant relationship between relational coordination and severe medication errors documented in both the main and interaction models. Conflicting results also were found for the direction of the relationship between these variables. The hypothesized direction of the relationship was supported in the main model, with higher quality relational coordination associated with fewer severe medication errors. Yet, in the interaction model, higher quality relational coordination was associated with more severe medication errors.

These findings are inconsistent with other studies in which coordination, teamwork, and communication among health care providers has been linked to fewer medication errors (Agency for Healthcare Research and Quality 2003; Dutton, & Heaphy, 2003; IOM, 1999; Kaissi et al., 2003; Morey et al., 2002; Pratt et al., 2007; Schmidt & Svarstad, 2002l; Schmitt, 2001). Although communication and coordination are important for reducing medication errors, it is possible that the Relational Coordination Scale may have been insufficiently sensitive to capture the specific type of communications and interactions that contribute to the prevention of medication errors. For example, nurses, physicians, and pharmacists may target their communication on issues like developing an appropriate plan of care for patients and deciding the best approach for pharmacological management of impending patient problems rather than medication error prevention.

None of the remaining hypotheses for severe medication errors were supported. In fact, unit size was the only contextual variable that was an independent predictor of severe medication errors in the main model, with a statistically significant and negative parameter estimate. This finding suggests that fewer medication errors were reported on larger units. Yet, in the interaction model, the direction of this relationship became positive and insignificant, meaning that more medication errors were reported on larger units. This latter finding is consistent with prior studies in which unit size has been positively correlated with the number of medication errors (Holley, 2006; Valentin et al., 2009).

Contextual-Structural Fit and Unit Effectiveness

None of the fit hypotheses were supported in this study. Both theoretical and methodological issues may contribute to the explanation of these results. The theoretical issues will be discussed first followed by the methodological issues According to contemporary SCT theorists (Ellis, Almor & Shenkar, 2002; Peteraf & Reed, 2007), the relationship between contextual-structural fit and performance outcomes is the result of a dynamic rather than a static process in which constant readjustments to fit are made over time. Specifically, changes in context without comparable changes in structure result in performance problems that can be attributed to misfit, requiring a readjustment of structure to reestablish fit. It is also possible that changes in performance outcomes rather than context trigger the need for structural adjustment. Donaldson (1987) argues that organizations do not recognize the need for contextual-structural fit adjustments until performance deficiencies that result from misfit are recognized. In either case, it is probable that contextual-structural fit results from an elongated process of readjustment that is more likely to be captured using a longitudinal rather than a cross-sectional study design.

Additionally, investigation of isolated three variable relationships may be of limited benefit in understanding the complexity of contextual-structural fit in organizations. In this study, for example, relationships among relational coordination and unit effectiveness, moderated by single contextual variables, were tested. Many SCT researchers now argue for the investigation of fit using a holistic or gestalt approach that is based on the assumption that superior organizational performance is the result of fit among multiple contextual and structural variables in combination (Betts, 2003; Birkinshaw et al., 2002; Ellis et al, 2002;

Gresov, 1989; Teasley & Robinson, 2005). Based on this approach, fit hypotheses are tested using variable clusters that represent multiple contextual and structural factors. Support for fit hypotheses, then, is suggestive of the combination of variables that that are associated with superior performance (Betts, 2003).

SCT theorists who have investigated fit among contextual and coordination-related concepts have reported mixed results. Two researchers, in particular, found support for the relationship of contextual-structural fit with organizational effectiveness as proposed in SCT. Alexander and Randolph (1983) found that fit between task variability, an indicator of technology, and horizontal participation, an indicator of structure, was significantly associated with effectiveness. Similarly, using the gestalt approach to the measurement of fit, Gresov(1989) matched clusters of contextual and structural variables to performance indicators and found support for the SCT premise of a relationship between contextual-structural fit and organizational performance. In contrast, researchers who have measured fit similar to the way it was measured in this study have been unable to find support for a relationship between contextual-structural fit and performance as proposed in SCT. Tushman (1979) found that fit between task analyzability as an indicator of technology and horizontal communication as an indicator of structure was not associated with performance .Similarly, Nidumolu (1996) used task uncertainty as an indicator of technology and vertical/horizontal coordination as an indicator of structure and found no association between contextual-structural fit and organizational effectiveness. Therefore, the inability to find support for the SCT fit premise in this study is consistent with the work of other researchers who used an approach to the measurement of fit that was comparable to that used in this study.

Contextual Variables

Methodological issues also may contribute to the explanation of the insignificant findings in this study. First, many of the variables included in this study were inter-correlated. For example, relational coordination was correlated with support service availability ($r = .29$, $p < 0.01$) and work complexity ($r = -.32$, $p < 0.01$), support service availability was correlated with workload ($r = .16$, $p < 0.01$) and work complexity ($r = -.23$, $p < 0.01$), and work complexity was correlated with unit size ($r = .23$, $p < 0.01$), workload ($r = .16$, $p < 0.01$) and patient acuity($r = .17$, $p < 0.01$). Despite lack of evidence of multicollinearity in these data, interrelationships among several contextual and structural variables may have contributed to the insignificant results.

Second, medical-surgical units were recruited in the ORNA-II study as sites for data collection, resulting in a homogeneous sample of nursing units. As a result, there was limited variability in these data for several of the variables included in this study. For example, the mean and standard deviation for patient acuity were 45.57 and 3.59, respectively, and acuity scores ranged from 34.5 to 56.67, suggesting that these units were characterized by only a moderate level of patient acuity. There also was limited variability in work complexity across these units (mean = 26.84, SD = 3.5, range =15.79 to 37.4). Finally, the mean and standard deviation for relational coordination was 226.06 and 12.67, with scores ranging from 157.40 to 262, suggesting limited variability in the quality of relational coordination among units.

Structural Variable

Relational coordination was conceptualized as a structural variable in this study, an approach that has been used by other SCT researchers. However, there has been a tendency in the SCT literature to use a mechanistic approach to the conceptualization of coordination. For example, coordination as a broadly defined structural concept often has been measured using indicators like horizontal communication or interactions to represent coordination among co-workers which then are incorporated with other indicators that represent the processes through which coordination is created like standardization and programming. In contrast, Gittell (2003) argues that relational coordination is not directly created through such mechanistic processes but rather emerges through a relational process in which co-workers develop connections that allow them to recognize the competencies of and be sensitive to the needs of co-workers as well as develop strong interpersonal bonds that are based on mutual respect (Gittell, 2003). In other words, while most SCT researchers have conceptualized and measured coordination in terms of the structural processes through which it can be created, Gittell (2003) argues that the role of structure is to create conditions that are conducive to the development of strong connections which, in turn, provides the framework through which relational coordination to emerge. For this reason, Gittell's argument suggests that relational coordination extends beyond traditional coordination, thus limiting the extent to which it can be conceptualized in the same way that traditional coordination as a structural variable has been conceptualized and measured in the past.

Along with possible theoretical issues associated with the conceptualization of relational coordination as a structural variable, methodological issues may have contributed to the insignificant findings for relational coordination in this study. For example, the sample for the parent study was medical-surgical nursing units. Unlike critical care units where patient acuity, work complexity, and workload can be highly variable, it is possible that much of the care on medical-surgical units is routine and, thus, does not necessitate the same level of high quality relational coordination that might be required in more high acuity areas. Further, the data for relational coordination may have been vulnerable to social desirability bias since ratings were obtained only from RNs on each unit. It is possible that these nurses may have over-rated the quality of their interactions with other providers, based on the belief that good relationships with physicians and pharmacists, in particular, are an expectation of the organization. Finally, the ORNA II data were collected in 2003 and 2004 which preceded the emphasis on the importance of high quality coordination and teamwork that is currently found in the healthcare literature. Therefore, it is possible that RNs who thought they worked well with physicians and pharmacists may have rated their relationships as more indicative of high quality relational coordination than they actually were.

Effectiveness Variables

Length of stay. Limited precision in the measurement of the effectiveness variables in this study may have contributed to the insignificant results. It is possible that the use of average length of stay may have been insufficiently sensitive to capture the relationship between contextual-structural fit and length of stay in this study. Further, it is possible that length of stay, as measured in the parent study, may not be a valid indicator of efficiency. A longer length of stay may be appropriate for some patients but unnecessary for others. Similarly, high quality relational coordination may contribute to a shorter length of stay when continued hospitalization is unnecessary but a longer length of stay when it is warranted by the condition of a patient. It is possible that measuring length of stay using the difference between expected and actual length of hospitalization may be a more sensitive measure of hospital efficiency. Similarly, Silber et al. (2003) has proposed an indicator of hospital efficiency called “conditional length of stay” which may better differentiate between necessary and unnecessary hospital stays by adjusting length of stay according to patients' discharge diagnosis. Adjusting the expected length of stay using discharge diagnosis may provide more sensitive measurement of hospital efficiency and, thus, improve the ability to document relationships among contextual-structural fit and efficiency.

Severe medication errors. Similarly, severe medication errors were measured in this study using the number of medication errors reported on the unit each month over six months. It is possible that the number of data collection points at which medication errors were measured in the parent study may have been insufficient to overcome the signal to noise ratio in these data. Since these errors occur randomly and are usually rare in number, measurement precision can be enhanced by including a larger number of observed events. This can be achieved by increasing sample size or increasing the number of time points at which an event is observed (Lipsey, 1990). Therefore, it is possible that the use of a longitudinal design with multiple data collection points may increase measurement sensitivity for severe medication errors.

Severe medication errors were measured in the parent study using incident report data. These data tend to be vulnerable to under-reporting. Although this analysis was limited to severe medication errors as a way to minimize the potential for under-reporting, it still may have been a source of bias. Finally, the distribution of scores for severe medication errors was positively skewed with a high percentage of zero values. Although a statistical approach that accounts for a high percentage of zero values was used in this study, the markedly skewed distribution of scores for severe medication errors may have contributed to the insignificant findings.

Study Limitations

The findings from this study must be interpreted in light of several limitations. First, this study was conducted using data that were collected for a larger study. Therefore, some variables that may have been relevant to this study were not included in the larger study. For example, diagnostic diversity on the unit can have implications for the quality of relational coordination. Nurses who work on units with greater diagnostic diversity typically interact with a wider variety of physicians and may not have the ongoing contact that is needed to establish high quality connections with multiple providers. Second, Gittell originally measured relational coordination in terms of five different healthcare provider groups. In the Relational Coordination Scale used in the ORNA-II study, the number of provider groups was increased to nine which added to the burden of completing this scale for participants. In addition, the nurses in this study may have had limited interaction with some provider groups which could have introduced a source of bias in the measurement of relational coordination. Third, the interaction approach used to test the fit hypotheses in this study assumes linearity among variables. It is possible that some relationships tested in this study were curvilinear (Meilich, 2006). However, curvilinearity was not assessed in this study.

Finally, the decision was made to limit this study to severe medication errors as a way to offset the potential for bias due to medication error under-reporting. Severe medication errors were defined as errors that result in increased nursing observation, technological monitoring, laboratory testing, radiographic testing, medical intervention, or transfer of the patient to another unit. In some hospitals, however, increased nursing observation is provided following all medication errors regardless of their severity, thus potentially compromising the validity of these data as a measure of severe medication errors only. Study coordinators from two of the hospitals in the ORNA-II study voluntarily reported that this approach was the policy in their institution. However, the extent to which other hospitals in the ORNA-II study followed a similar policy is unknown.

Recommendations for Future Research

Several recommendations for future research are suggested. The interaction approach evaluates the moderating effect of an individual contextual variable on the relationship between structure and effectiveness. Measuring fit using bivariate relationships that are moderated by a third variable may be inadequate to capture the relationship between contextual-structural fit and organizational effectiveness. Efforts to investigate SCT fit may benefit from the use of a gestalt approach in which fit is evaluated using variable clusters that includes multiple contextual and structural factors. Moreover, as suggested by Donaldson (1987), effective organizations adapt to changing contextual conditions through a dynamic cycle of fit, misfit, and readjustment to fit. The conceptualization of "structural adaptation to regain fit" suggests the need to test fit hypotheses using longitudinal designs that can better capture the fit cycle in organizations (Donaldson, 1987, p. 1).

Other theoretical approaches like Gittell's theory of relational coordination or an organizational learning theory may be better suited to the investigation of the relationships among relational coordination and organizational performance. Gittell's theory is specific to relational coordination and identifies design characteristics that have the greatest potential to influence the quality of relational coordination at the work unit level. For example, this theory incorporates routines, boundary spanners, and leadership as design factors through which high quality relational coordination can be supported (Gittell, 2003). From the learning organization perspective, relational coordination can be conceptualized as a process through which organizational learning can be facilitated and used to manage uncertainty and keep the organization viable (Easterby-Smith, 1997; Reynolds, & Marquardt, 1994).

In addition to these recommendations, a reliable and valid approach for measurement of medication errors is needed. The reluctance of healthcare providers, including nurses, to report medication errors has been well documented. Reasons for this reluctance include not only fear of punishment, but also different opinions about what constitutes a medication error and whether or not an error is or could be harmful to a patient. Although Morimoto et al. (2004) classified medication error severity as fatal, life threatening, serious and significant, there continues to be lack of standardization across hospitals in classifying medication error severity. Further, chart reviews have been identified by some authors as the best way to measure medication errors (Grasso, Genest, Jordan, & Bates, 2003; Jain, Basu, Parmar; 2009; Lemer et al., 2009). However, chart reviews also have been criticized because they are labor-intensive and often result in unreliable data (Bates et al. 1995a, 1995b; Jain et al.2009; Lemer et al., 2009). Despite these concerns, Resar and colleagues (2003), working with the Institute for Healthcare Improvement, have developed a standardized chart review methodology in which triggers like adverse drug events are used to guide data extraction. Resar and colleagues have reported that a chart review with an acceptable level of interrater reliability can be completed in no more than 20 minutes when using this methodology. It is possible that data obtained using both incident reports and chart reviews may lead to improved measurement of medication errors.

Chapter Summary

In this chapter, significant findings from this study were compared with finding from the literature, and both theoretical and methodological explanations for the insignificant findings were identified. Further, limitations of this study and recommendation for future research were discussed. None of the contextual-structural fit hypotheses developed for this study were supported, suggesting that the interaction approach may not provide an adequate evaluation of SCT fit. In addition, greater sensitivity in the measurement of several of the variables included in this study may be needed to explain the phenomena of contextual-structural fit and effectiveness in organizations. Continued research is needed to explain the relationship between contextual-structural fit and effectiveness in organizations.

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