Relationships Among Organizational Context, Structure, and Medication Errors in Taiwanese Nursing Units

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ABSTRACT

Chang-Chiao Hung: Relationships Among Organizational Context, Structure, and Medication Errors in Taiwanese Nursing Units
(Under the direction of Mary R. Lynn)

Although efforts to prevent medication errors have focused on identifying factors at the macro-level, only a few studies of these factors have been conducted. Thus, there is limited information on error prevention based on a macro-level perspective. Therefore, this study was conducted to explore the relationships between macro-level factors and medication errors.

Structural contingency theory was used as the framework for the study. A cross-sectional design was used and data were collected through self-administered questionnaires. Dillman’s (2007) Tailored Design Method was used for data collection. A total of 1,300 staff nurses and 65 head nurses who worked in three hospitals in southern Taiwan were invited to participate in the study. Pearson’s Product Moment (PPM) correlations and t tests were used for data analysis.

Five nurse experts assessed content validity of the Unit Technology Instrument and 12 items with an acceptable content validity index were retained. Sixty-two head nurses (96.8%) and 977 staff nurses (72%) completed and returned the questionnaire. Reliabilities for all instruments used in the current study ranged from 0.71 to 0.83. Discriminant validity of the Unit Technology Instrument and the Attitude on Participation Scale was tested and a non-significant finding was derived. Eta-squared coefficient ($\eta^2$), inter-item consistency ($r_{wg}$), and F ratio showed that data at the individual level were appropriate to aggregate to the unit level.
Four variables, technology, skill mix, unit size, and unit type, were significantly associated with medication error rates. Only nurse experts and unit size were significantly related to professional autonomy, which was the only variable in practice structure that had a relationship with medication errors.

This study provides support for the use of macro-level approaches to examine medication error issues. Findings from the study may help head nurses develop nursing practice structures that adequately support balanced power in practice.
ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS AND SYMBOLS

α  Cronbach’s Coefficient Alpha
ADE  Adverse Drug Event
ADR  Adverse Drug Reaction
BCMA  Bar-Coded Medication Administration
CPOE  Computerized Provider Ordering Entry system
CVI  Content Validity Index
EFA  Exploratory Factor Analysis
$\eta^2$  Eta-squared
ICU  Intensive Care Unit
IOM  Institute of Medicine
IRB  Institutional Review Board
NA  Nurse Assistant
NCC MERP  National Coordinating Council for Medication Error Reporting and Prevention
PDM  Participation in Decision Making
PPM  Pearson’s Product Moment Correlation
PNAS  Professional Nursing Autonomy Scale
PNQ  Pankratz Nursing Questionnaire
$r_{wg}$  Within-group Agreement
RN  Registered Nurse
SCT  Structural Contingency Theory
SD  Standard Deviation
SPSS  Statistical Package for the Social Sciences
$SS_b$  Between Groups Sum of Squares
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**Introduction**

Medication errors have long been identified as a major safety issue for healthcare organizations, both in the United States (U.S.) and globally. The Institute of Medicine (IOM) has reported that approximately 1.5 million preventable adverse drug events occur each year in the U.S., and on average, one person is killed by a medication error every day (Menachemi & Brooks, 2006). In Taiwan also, there are concerns about medication errors. In 2003 and 2004, the Taiwan Joint Commission on Hospital Accreditation (2006) conducted surveys on medical negligence and found that among the 13 types listed, giving the wrong oral medicine was the most frequent. This occurred twice as often as hospital acquired infections, the second leading type of medical negligence. Similarly, Lin (2008), who sampled 61 hospitals in Taiwan, found that medication errors were the most frequent adverse medical events. When Hsu (2005) surveyed 1,352 Taiwanese nurses, all said that they had made at least two medication errors in their nursing career. Similar findings have been reported by Huang (2007).

The first step in preventing medication errors is identifying the factors that predispose staff nurses to commit medication errors. Scholars have proposed that such factors contribute to errors at three levels: micro, meso, and macro levels (Ferlie & Shortell, 2001; Mick & Mark, 2005). Micro-level factors include healthcare providers’ fatigue, insufficient attention, or lack of skill or knowledge due to individuals’ physiological or cognitive problems, or the level of education or training provided to workers. Meso-level factors are related to group or team dynamics, including team membership, communication, degree of team integration, leadership, and safety culture or
climate. Macro-level factors include technology, environment, and organizational size, which affect structural adaptations (Ferlie & Shortell, 2001; Institute of Medicine, 1999, 2001; Mick & Mark, 2005).

Although examination of all three levels has been cited as essential in exploring errors, Reason (2000, 2004) noted that interventions to decrease medication errors and enhance patient safety should focus on “latent” errors that derive from failures in a system of care and poorly designed systems within organizations, i.e., macro- and meso-level factors, rather than on “active” errors that derive from individual actions or micro-level factors. Unfortunately, little research has focused on macro-level factors in medication errors (Hoff, Jameson, Hannan, & Flink, 2004; Mick & Mark, 2005). Further, the few studies conducted have had methodological weaknesses, such as ambiguous definitions of study variables and lack of a systematic theoretical framework (Hoff, et al., 2004). These weaknesses prevent health care organizations from being able to identify the organizational dynamics that impact medication errors and patient safety outcomes. Finally, the macro-level studies conducted to date were all done in Western countries. Healthcare organizations in Eastern countries may not be able to use information from these studies to understand macro-level shortcomings in their organizations or to implement interventions, because their systems and cultures differ from healthcare organizations in the West. For instance, the Taiwanese nursing system has no licensed practical nurse and hospitals tend to be very large, which increases the complexity of the nursing environment. In addition, supervisors or head nurses of Taiwanese hospital units tend to make decisions for their nurses and units.

In summary, given the limited research on macro-level factors that affect patient safety, our understanding of how to reduce the risk of system failures that impact patient safety outcomes in Taiwanese healthcare organizations is limited. This study was
therefore designed to determine which macro-level factors were associated with medication errors, rather than to understand how micro-level factors affected medication errors. The study used organizational theory as the framework for examining macro-level factors in three Taiwanese hospitals. This is the first study to use organizational theory in exploring factors in medication errors in nursing units in Taiwan.
CHAPTER I

BACKGROUND AND THEORETICAL FRAMEWORK

This chapter begins with a discussion of the prevalence and impact of medication errors in healthcare systems. The next section provides a definition and classifications of medication errors in hospitals, and discusses causes of medication errors including human actions and working conditions. Two types of medication error resistance strategies used in hospitals are described: error management and prevention. Three levels of prevention of medication errors are noted. Then, structural contingency theory, which describes the relationships among organizational context, structure, and performance, is presented. The concepts and variables of structural contingency theory are described, and finally, the study’s conceptual framework, based on structural contingency theory, is depicted.

The Prevalence and Impact of Medication Errors

Medication therapy is the primary intervention for illness treatment; however, patients experience harm from medication interventions as well as benefits. Medication errors are common. In the U.S., deaths caused by prescription errors increased 243% over the 10 years from 1983 to 1993 (Phillips, Christenfeld, & Glynn, 1998). According to the MEDMARX voluntary medication error tracking system, in 2002 approximately 200,000 medication errors were reported (Lafleur, 2004), and the National Academies Organization (2006) has reported that approximately 1.5 million preventable adverse drug events occur every year in the U.S. Empirical studies have shown that medication errors may be occurring as frequently as one per patient per day (Leape, Bates, Cullen, et al., 1995; Wu, 2006). One study which used direct observation, unannounced control visits,
and chart reviews to detect errors in the medication process found 1,065 errors committed by healthcare providers in 64 patient hospitalizations. Of these 1,065 medication errors, 166 occurred in the administration stage (Lisby, Nielsen, & Mainz, 2005).

Medication errors have an impact on both morbidity and mortality. In 2001, the Audit Commission (2001) estimated that medication errors accounted for approximately one-fifth of deaths from adverse patient events and increased patient stays by about 8.5 days. Menachemi and Brooks (2006) have reported that on average, one person is killed by medication errors every day, and medication errors are somewhere between the fourth and seventh causes of deaths in the U.S. (Lazarou, Pomeranz, & Corey, 1998).

Preventable medication errors harm at least 1.5 million people per year, and at least $3.5 billion for treating preventable hospital drug-related injuries are added to annual health care costs. These costs do not include people’s wages and lost productivity, or the government’s or hospitals’ efforts to prevent medication errors (National Academies Organization, 2006). The Society of Actuaries (2010) has estimated that lost productivity results in an expense of $1.1 billion. In the United Kingdom (UK), the Department of Health (2000) has estimated that the cost of additional hospital stays because of medication errors is around £ 2 billion a year.

Definitions of Medication Errors

The term “medication error” is frequently used to describe both medication error occurrences and medication-related issues. Medication errors can be caused by errors in both the planning and execution of the medication process. The most common definition of medication error is that approved by The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) in 1998:

"... any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the health care professional, patient,
or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.

Medication errors can and do occur in any stage of the medication process, including ordering/prescribing, transcribing/verifying, dispensing/delivering, and administering, regardless of whether or not injury occurs (Bates, Boyle, Vliet, Schneider, & Leape, 1995; Leape et al., 1995). The three stages, other than administration, are all a part of medication planning; that is, the medication has not yet been administered to the patient. There is no harm to the patient because the medication error is intercepted before reaching the patient; however, any error reveals inadequate procedures and systems in hospitals. Administration is the execution stage, and this receives more attention by healthcare providers because it is the final stage in committing medication errors. For professional practice, “Five Rights” – right patient, right drug, right dose, right route, and right time-- are standards that should be addressed in the administration stage to prevent medication errors. Once any of the “Five Rights” is violated, medication error occurs.

Two terms, adverse drug events (ADEs) and adverse drug reactions (ADRs), are widely used and misused in regard to medication errors. ADEs, which may result in conspicuous or inconspicuous harm, are injuries that result from drug use, including delivery or failure to deliver an intended medication (Shih & Su, 2004). ADEs with inconspicuous harm are considered potential ADEs because the patient is able to absorb the medication without any uncomfortable symptom or physical harm (Hughes & Blegen, 2008). Some ADEs are preventable; those which are not preventable are often the result of adverse drug reactions (ADRs). The Joint Commission (2007) has defined an ADR as “an undesirable response associated with use of a drug that either compromises
therapeutic efficacy, enhances toxicity, or both.” The Joint commission notes that ADRs can occur even when medications are administered properly. The majority of ADRs are not preventable. The reaction involves conspicuous or inconspicuous symptoms that negatively affect the patient’s prognosis and result in temporary or permanent harm, disability, or death. But, again, not all or even most ADRs are the result of medication errors.

Physicians, pharmacists, nurse practitioners, and nurses are involved in the medication delivery process. Typically, physicians and nurse practitioners are involved in the ordering/prescribing stage and may initiate a series of errors resulting in adverse consequences. The wrong drug and dose can be ordered in this stage. Potts and colleagues (2004) reviewed 6803 medication orders in a 20-bed critical care unit in a children’s hospital and found that 30.1% (2049) involved prescribing errors. In a 22-bed critical care unit, Colpaert et al. (2006) found that 27% (331/1224) of medication errors were hand-written medication prescription errors. Transcribing and dispensing errors are not rare in studies of pharmacists. Leape et al. (1995) found that dispensing errors made up 14% of total adverse drug events. A recent report found that dispensing errors by pharmacists ranged widely, from 4% to 42% (Walsh, Kaushal, & Chessare, 2005). Nurses in hospitals are involved in the transcribing, dispensing, and administering stages, and administering medications has been considered the most important job for nurses. Armitage and Knapman (2003) found that nurses spent as much as 40% of their time in medication administration. In Lisby et al.’s (2005) study mentioned above, 38.7% (416) of the administering errors were committed by healthcare providers. Miller and her associates (2007) reviewed 31 pediatric articles and found that the percentages of errors in administering medication that were made by nurses ranged from 72% to 75%.
Causes of Medication Errors

Causes of medication errors have been categorized as human actions and working conditions (Hughes & Blegen, 2008; Rasmussen, 1982; Senders & Moray, 1991). Human action as a course of error is defined as an action that fails to meet an explicit standard or plan that is designed to achieve a desired outcome and that cannot be attributed to an unforeseeable event (Reason, 1997; Senders & Moray, 1991). Goals are not achieved either because of action failure or inappropriateness of the plan. Sometimes, the plan is adequate but people fail to take the proper actions. Reason (1997) termed failures of execution as slips and lapses. A slip refers to lack of attention and perception, and a lapse refers to a failure of memory. For instance, Buckley and colleagues (2007) observed the medication process over 6 months and found that slips and memory lapses were associated with 46.7% of medication administration errors. Kopp et al. (2006) had similar findings.

If people’s actions exactly follow the plan, but the plan is inappropriate, the goal also cannot be achieved. This is called a mistake that is related to an incomplete rule or lack of knowledge (Reason, 1997). For instance, some medication names, packages, and nomenclature may sound or look alike, leading to error associated with verbal prescriptions and administering (Chuang, Lin, Wang, Chung, & Cham, 2007; Institute of Medicine, 2007; Taiwan Joint Commission on Hospital Accreditation, 2006).

Many scholars have considered the relationships between medication errors and working conditions, e.g., equipment, systems, and environments (Reason, 2000). The IOM (1999) proposed that working conditions can facilitate medication errors, and their examination of deaths caused by medication errors targeted system factors, including staffing, workload, policies, procedure, and process factors, including distractions,
interruptions, documentation, communication, equipment, and complexity (Hughes & Belgen, 2008).

This approach to safety emphasizes that humans are fallible and errors will occur, even by the best people working in the best organizations. The approach focuses on identifying factors in the working environment or system that lead to errors (Reason, 2000). Reason’s (2000, 2004) human error model has two categories: active failure and latent conditions, which describe working conditions that can lead to errors. Active failures are unsafe actions which are implemented by frontline employees due to slips, lapses, or mistakes. Latent conditions are related to organizational processes, management decisions, and elements in the system such as an inappropriate proportion of registered nurses, staff workload, or medication administration protocols in a unit (Blegen & Vaughn, 1998; Manias, Aitken, & Dunning, 2005; Tang, Sheu, Yu, Wei, & Chen, 2007). According to Reason’s model, when human and nonhuman elements do not appropriately interact, or when procedures, policies, or strategies from decision makers at the management level are unable to prohibit individual failure actions by frontline employees, errors occur. Thus, accidents are derived from latent conditions, and errors are consequences, not causes. Efforts to prevent errors should therefore search for factors in “latent” conditions (Kohn, Corrigan, & Donaldson, 2000; J Reason, 2000, 2004).

**Medication Error Improvement Strategies: Management versus Prevention**

Efforts to address the difficult problem of medication errors are widespread among hospitals. Strategies include error management and error prevention (van Dyck, Frese, Baer, & Sonnentag, 2005). Error management refers to actions to deal with errors before they lead to disastrous consequences (Reason, 1997). The process of error management extends from the occurrence of an error to compensation for the consequences of the error and includes error detection (i.e., awareness and recognition of error occurrence), error
identification (i.e., analysis of error occurrence), and error handling (i.e., compensation for the error consequence). Error reporting, retrospective chart review, and direct observation all have been used to detect medication errors (Michel, Quenon, de Sarasqueta, & Scemama, 2004; Olsen et al., 2007). Root cause analysis has been commonly used in error analysis and explanation in healthcare industries. Apologies to patients who experience errors and compensation for drug-related injuries are widely used ways to compensate for error consequences in the health care system (Leape, 2006; Sparkman, 2005). Error management has long been considered the most important means to achieve patient safety; however, no evidence exists that hospitals with a high volume of error detection, identification, and compensation for error consequences are safer for patients.

Error prevention is conceptualized as the attempt to block the sources of errors, including erroneous actions and system design (Reason, 1990). Error prevention is viewed as an intervention stage in which the sources of errors are analyzed to prevent individuals from recommitting errors, thereby blocking the possibility of an error proceeding to disastrous consequences. To implement a preventive intervention, it is important to understand the underlying problems that lead to errors. Medical researchers, social psychologists, and organizational theorists have examined errors at three levels: micro, meso, and macro levels (Ferlie & Shortell, 2001; Mick & Mark, 2005). Studies at the micro level, the individual level, have focused on human actions and have shown that errors are committed because of physiological, knowledge, skill, cognitive, intention, and emotional factors, including fatigue, insufficient attention, new staff, or lack of double-checking. Therefore, prevention of micro-level errors includes individual-focused interventions such as Bar-Coded Medication Administration (BCMA), the Computerized Provider Ordering Entry system (CPOE), precise infusion devices, and continuing
Error prevention at the meso-level, or the group or team level, has its origins in system engineering and team reliability assessment. Meso-level studies on medication errors have focused on how front-line nurses who are affected by team-related dynamics (e.g., team integration, team effectiveness, and team communication), as well as culture. The publications, *To Err Is Human* (Institute of Medicine, 1999) and *Crossing the Quality Chasm* (Institute of Medicine, 2001) note that a strong patient-safety culture, appropriate leadership, and greater coordination of care contribute to a successful group/team-based approach to reducing errors and enhancing patient safety. For instance, Edmondson (2004), who explored the effects of group- and organizational-level factors on administering drugs to hospitalized patients using 1089 surveys from nurses, physicians, and pharmacists in 8 units, she found that nurse manager coaching ($r = .74; p < .03$) and nurse manager direction setting ($r = .74; p < .03$) were significantly related to detected error rates.

Macro-level studies, at the structural level, emphasize the need for standardization, professionalization, or formalization of health care processes, as well as the use of decision making in the process (Institute of Medicine, 1999, 2001). For instance, *To Err Is Human* emphasizes the need for simplification and standardization of work in complex care delivery processes, such as medication administration. Rather than trying to explain why an individual commits errors or how lack of a successful group/team-based approach leads to errors, macro-level studies emphasize how factors give rise to errors via the influence of structure. Some researchers have used organizational theory to explore macro-level factors that affect structure (Alexander & Bauerschmidt, 1987; Alexander & Randolph, 1985; Argote, 1982; Perrow, 1984). For instance, Perrow (1984) noted that as
technology increases the complexity of an organization, “chain reactions” in the other components of the organization (e.g., structure) increase, and unsatisfactory performances occur.

Although all three levels have been noted as potentially important in addressing errors and patient safety, macro-level factors that impact safety outcomes have largely been ignored (Mick & Mark, 2005; Hoff, Jameson, Hannan, & Flink, 2004). Only a few studies have used a macro-level approach to examine the relationships between environment, organization, structure, and patient safety outcomes, and in these studies organizational and structural concepts were often ambiguously defined or not defined at all (Gaba, 2000; Pronovost et al., 2006). Additionally, some studies had no systematic theoretical framework for explaining the effects of organizational factors on structure and safety outcomes (Cullen et al., 1997; Poe et al., 2001), and some studies provided no information on their methodology or no specific findings about study variables (Meisel, Sershon, & White, 1998; Weeks, Mills, Dittus, Aron, & Batalden, 2001). Further, all of the studies were conducted in Western countries (Hoff et al., 2004).

Pronovost et al. (2006) used an organization-wide framework to evaluate patient safety performance in intensive care units. The framework included patient factors, task factors, team factors, training and education, information technology, local environment, and institutional environment. However, the authors did not discuss the boundaries of the organization, or define study variables, or their theoretical framework.

Hoff et al. (2004) reviewed 42 studies that were extracted from 2,445 studies examined in two rounds of reviews that investigated linkages between organizational factors, medical errors, and patient safety. They found that 61.9% of the studies (26/42) had no theoretical framework and 31% (13/42) included no findings in the article though the authors concluded that there were linkages between variables. Hoff et al. also found
that in these 42 studies, researcher(s) derived the organizational factors examined from IOM reports and other publications, but the factors were not necessarily comprehensive. Although Hoff et al. used only English language journals and a few specific terms (i.e., medical errors and patient safety) to search the literature, their findings suggest that empirical studies of medical errors and patient safety at the macro-level are mixed, and the findings are often anecdotal.

Thus, little is known about error prevention from a macro-level approach, in part because the studies reported to date have had methodological limitations. This study used structural contingency theory (SCT) to explore factors associated with medication errors. SCT has an assumption that a low degree of performance is due to system failures that derive from an organizational structure unable to adequately react to contingencies.

**Conceptual Framework**

A health care system is an open and complex system which is characterized by nonlinear interactive components, continuous and discontinuous change, emergent phenomena, and unpredictable outcomes (Zimmerman, Lindberg, & Plsek, 1998). Individuals working in this system face challenges from minute to minute, from both internal and external environments. To understand how the environment affects organizational structure and how these components interact to influence medication errors in Taiwanese hospitals, structural contingency theory (SCT) was used as the conceptual framework for this study.

**Structural Contingency Theory**

The central theme of Structural Contingency Theory (SCT) is that the structure of an organization must appropriately react to contextual factors for an organization to succeed and to be effective. SCT states that organizational performance depends on the degree of adaptation of the organizational structure to its context. Donaldson (1995) proposed that
appropriate and efficient organizational structures vary depending on the organizational context. That is, SCT proposes no standard structure and no standard procedure for an organization to follow in deciding on structure; rather, an organization should adopt the most appropriate organizational structure and managerial method in the particular environment it faces.

This view is based on two assumptions. First, there is no best way to organize and structure an organization, so there is no best structure to use to adapt to fluctuations of the environment or changes in tasks (Schoonhoven, 1981). The nature of an organization is determined by its environment or task. Morgan (1986) noted that all parts of a system are closely intertwined, and if there is change in any element of the system, other elements of the system are influenced. Further, no one way of organizing is equally effective under all conditions (Galbraith, 1973). Leatt and Schneck (1981) thus proposed that “there is no universal type of organizational structure but only a multiplicity of possible alternative methods of organization” (p.221).

The components of SCT include organizational context, structure, and performance. These components are discussed below.

**Organizational Context: Technology and Environment**

Organizational context refers to the contingencies that an organizational structure has to deal with in order to make adaptive change and ensure maximum performance. Research into organizational context has identified a number of sources of contingencies. Technological complexity (Woodward, 1980), environmental complexity (Leatt & Schneck, 1981, 1982), task uncertainty and interdependence (Donaldson, 2001), and size (Donaldson, 2001) are some of the better known components of organizational context. Two major components of organizational context that are generally used to represent contingencies are technology and environment.
Technology

Technology is a characteristic of organizations that can be perceived as a system for getting work done, i.e., applying techniques to change raw materials, rather than a cooperative or decision-making system. Based on this perspective, Perrow (1967) defined technology as “the actions that an individual performs upon an object, with or without the aid of tools or mechanical devices, in order to make some change in that object. The object or raw material may be a living being, human or otherwise, a symbol, or an inanimate object” (p.195). For instance, in people-changing organizations, such as health care systems, patients are the raw materials. The actions that an individual performs on an object determine the tasks that the individual has to complete. From the perspective of structural contingency theory, the task is the work that brings the interactions of individuals to achieve outcomes (Mark, Sayler, & Smith, 1996). The interactions of individuals traditionally were viewed as organizational structure, and maintaining and controlling the organizational structure was considered managers’ key role. Perrow (1967) noted that the difference between organizational structure and technology is that structure reflects the interactions among workers in the course of trying to change raw materials, and technology is the interactions between raw materials and workers. Although the purposes of the interactions are consistent, the interactions differ.

Three aspects of organizational technology have been discussed by researchers: variety, analyzability, and stability (Alexander & Randolph, 1985; David, Pearce, & Randolph, 1989; Leatt & Schneck, 1981, 1982; Overton, Schneck, & Hazlett, 1977; Perrow, 1967; Sicotte & Beland, 2001). Variety and analyzability have been discussed based on the uncertainty of the task. Variety, which is the number of types and the variations in events that occur in the conversion process, reflects the number of distinct tasks. Analyzability is the degree of the conversion process that can be handled by
existing instructions, protocols, handbooks, or procedures when exceptions occur.

Stability refers to the frequency of unanticipated change or the degree of variation occurring in raw material. These three aspects are used to classify technology in two categories: routine and nonroutine (Dewar & Werbel, 1979; Fry & Slocum Jr, 1984; Perrow, 1967). Routine technologies tend to have little variety, high analyzability, and stability. Nonroutine technologies are characterized by high task variety, low analyzability in the conversion process, and instability in the nature of the raw material.

Because little empirical research has been done on technology in human service organizations, Overton et al. (1977) used Perrow’s (1967) conceptual framework to develop a technology instrument, then used this instrument to identify the characteristics of technology in seven types of nursing subunits, including pediatric, intensive care, rehabilitation, psychiatric units, etc. Data analysis was done on 340 questionnaires obtained from nurses on 71 nursing subunits. After factor analysis, the 35 items of the initial technology instrument were reduced to 28 items, which accounted for 61% of the variance. Three underlying technological dimensions were identified: variability, instability, and uncertainty. Variability referred to differences in patients’ health problems and their participation in planning their care. Instability referred to the number of unexpected events, such as emergencies, in the work, and the amount of nursing care and equipment required. Uncertainty referred to the degree to which nurses were deficient in clinical knowledge to deal with patient conditions and adequately apply techniques (Overton, et al., 1977). Overton et al. calculated the means of each factor for the 7 types of nursing subunits and used the Newman-Keuls procedure to compare all pairs of means. Significant differences were found between some of the types of subunits. For instance, psychiatric units had a significantly higher degree of variability \((r = 11.54; p = .05)\) and instability \((r = 14.41; p = .05)\) than intensive care units, however, no significant
differences were found in degree of uncertainty. Overton et al. concluded that nursing units had different degree of technology. The technology instrument developed by Overtone et al. for nursing units has been used in additional nursing studies, such as Leatt and Schneck (1981, 1982), and Alexander and Randolph (1985). Since Overton et al. had not named the instrument, for the purpose of discussion, the instrument is simply called the Technology Instrument.

Environment

The organizational environment, generally defined as the background, systems, and conditions that exist in the work setting and surround employees, influences the ability of an organization to maximize its performance (Cumbey & Alexander, 1998). Duncan (1972) proposed a widely accepted categorization of the environment as external and internal. The external environment consists of relevant physical and social factors that affect the organization but are outside the boundaries of the organization. This view of the external environment is close to Daft’s (2009) view of general environments that “exist outside the boundary of the organization and have the potential to affect all or part of the organization” (p.136), such as financial resources and economic conditions.

The internal environment consists of relevant physical and social factors within the boundaries of the organization, including structure, size, the characteristics of employees, etc. (Duncan, 1972). Factors in the internal environment have direct impacts on organizational operations. The internal environment is similar to the task environment, defined as “the organizational sectors with which the organization interacts directly and that have a direct impact on the organization’s ability to achieve its goal” (p.136) (Daft, 2009). The external environment of an organization is composed of the characteristics of the organization, and the internal environment is composed of factors that have a direct impact on units’ operations (Umanath, 2003).
In some studies, organizational subunits are viewed as complete though smaller organizations. In this view, the external environment for a nursing unit includes the characteristics of the hospital, such as teaching status, hospital accreditation, ownership, and size. The internal environment is those things that affect the operation of the nursing unit, including the characteristics of the nursing unit itself, e.g., staff composition, nurse experts, unit size, and type of unit (Mark et al., 2008; Mark, Salyer, & Wan, 2003; Thomas & Brennan, 2000).

**Organizational Structure**

Organizational structure reflects formal reporting channels, identifies the positions of individuals, and provides paths for communication, coordination, and integration in the organization. Thompson (2003) defined structure as an organization’s internal pattern of relationships, authority, and communication. The basic functions of organizational structure are to produce organizational outputs and achieve goals; to minimize the influence of individual variation; and to provide a setting in which power is exercised, decisions are made, and activities are completed (Hall, 2002).

Some scholars have noted that organizational structure can be divided into two types: mechanistic and organic. A mechanistic structure is characterized by formalization, vertical participation, and centralization, with decisions made at the top level (Robbins, 1990). An organic structure is characterized by non-formalization, horizontal participation, and decentralization. The type of organizational structure depends on the characteristics of structural dimensions; centralization and formalization are the most common dimensions used by organizational theorists to illustrate type of organizational structure (Sheu, 1999).

Centralization implies that a few individuals at the top level of the organization ultimately make the decisions, while decentralization means that authority is shared with
lower level employees. The degree of centralization of the organizational structure reflects the distribution of authority in the organizational hierarchy and indicates whether the organization is mechanistic or organic (Pugh, Hickson, Hinings, & Turner, 1968; West, 2001).

The major factor that has been used to measure degree of centralization is autonomy, defined as the degree to which an individual carries out a task without supervision and governance (Hackman, 1980). Batey and Lewis (1982) proposed that autonomy can be defined as the freedom and discretion to make decisions consistent with one’s scope of practice. Scholars have noted that autonomy can be divided into two dimensions: autonomy and participation in decision making. Autonomy is related to individual tasks, and participation in decision making involves making administrative decisions regarding practice. In nursing, for example, autonomy consists of clinical practice autonomy and organizational autonomy (Keenan, 1999; Kramer, Maguire, & Schmalenberg, 2006; Scott, Sochalski, & Aiken, 1999; Wade, 1999). Clinical practice autonomy is professional autonomy; that is, nurses make professional decisions related to patient care; and organizational autonomy, or participation in decision making, means that nurses make administrative decisions guiding the unit’s development. Aiken and her colleagues, based on a series of studies that explored the impacts of characteristics of magnet hospitals on hospitals’ and patients’ outcomes, have proposed that professional autonomy and participation in decision making are characteristics of professional practice structure (Aiken, Clarke, Sloane, Sochalski, & Siber, 2002; Aiken, Sloane, & Sochalski, 1998; 1994).

Formalization indicates the extent to which employees’ roles, actions, or tasks are guided by formal instructions, procedures, and rules (Anderson, Issel, & McDaniel Jr, 2003; Leatt & Schneck, 1982). John and Martin (1984) defined formalization as “the
emphasis placed on following specific rules and procedures in carrying out plan formulation, including documentation of planning activities and adherence to job descriptions” (p.172). From this perspective, formalization implies that the organization/manager tends to control manufacturing processes/employees’ behaviors by implementing rules or procedures in order to ensure that the manufacturing processes/employees’ behaviors proceed along on an anticipated trail.

**Organizational Performance**

Organizational performance is the productive output of the organization. Definitions of organizational performance vary. Venkatraman and Ramanujam (1986) viewed performance as a subset of the broader concept of organizational effectiveness, while Tosi and Slocum (1984) said that performance refers only to profitability or to organizational adaptation and survival.

Organizational performance in hospitals generally has two aspects: employee-oriented and customer-oriented. The employee-oriented view of organizational performance measures hospital performance in terms of employees’ job satisfaction, degree of conflict among employees, and employees’ commitment to the hospital or unit (Drazin & Van de Ven, 1985; Fry & Slocum Jr, 1984). Evaluation of customer-oriented performance in a hospital includes patient satisfaction, patient safety, adequacy of patient education, and patient outcomes (Alexander & Randolph, 1985; Schoonhoven, 1981). Since medication error rate is a patient safety indicator and it was the major outcome measure in the current study, the focus of organizational performance in the study was on the patient safety aspect of customer-oriented performance.

In nursing, common indicators of patient safety include adverse events (e.g., medication errors and falls), infections, physical restraint use, and mortality (Anderson, et al., 2003; Stone et al., 2007). Buerhaus and Needleman (2000) recommended including
medication errors, patient falls, nosocomial infections, skin breakdown, length of stay, and mortalities as nurse sensitive adverse events. However, Mitchell and Shortell (1997), who reviewed 81 studies that examined the relations among organizational structures or processes and adverse effects, found that some adverse effects, e.g., complications or mortality, were heavily influenced by patient characteristics. Mitchell and Shortell concluded that medication error may be a more adequate measure of patient safety than other indicators because patient characteristics have little effect on this and thus do not confound the ways in which the organizational environment and management of hospitals affect patient safety outcomes.

Relationships among Organizational Context, Structure, and Performance

Fit is a key concept in the study of contingency relationships. As noted earlier, the basic assumption of structural contingency theory is that when organizational structure adequately reacts to the organizational context, higher performance is achieved. Good fit increases performance; accordingly, organizations seek a good fit to increase their chances of better performance. When the combination of organizational context and structure yields poor performance, this is seen as a poor fit. In other words, it is the fit between structure and context that affects performance. This explains the importance of associations between organizational context and structure, and also explains how organizational context affects performance. To achieve high performance, organizations have to shape their structure to fit their context. Fit dictates the relationship between organizational context and structure and explains variations in organizational performance (Donaldson, 2001). Therefore, fit is central in contingency theory.

Operational concepts involved in fit have been discussed by various scholars, including Fry and Smith (1987), Umanath (2003), and Van de Ven and Drazin (1985). Two prominent concepts in fit are congruence and contingency (Fry & Smith, 1987;
Donaldson, 2001; Umanath, 2003). When authors look at congruence, they are generally examining the relationship between organizational context and structure; congruence does not take into account the effect of organizational performance (Umanath, 2003). Congruence is examined to determine the laws of relationships among variables when a new organization is established or when organizational context and structure have not been explored. Since congruence reflects the relationship between two variables, simple correlations or $t$ tests are common in analyses of congruence.

In contrast, contingency considers the fit between two variables, one in the organizational context and the other in the organizational structure, in relationship to a third variable (performance). Therefore, contingency reflects fit-performance relationships. If good performance occurs, the combination indicates a good fit; as noted earlier, poor performance indicates a poor fit. For instance, Alexander and Randolph (1985) demonstrated that the fit of vertical participation (organizational structure) to the instability of technology (organizational context) was a significant predictor of performance.

Umanath (2003) proposed that organizational structure reflects the intervening effects in the relationship between organizational context and performance. That is, organizational structure mediates the effect of context on performance. As David and colleagues’ (1989) work illustrated, low task predictability and high horizontal differentiation lead to high performance. Task predictability has no direct effect on performance; rather, horizontal differentiation mediates the relationship between task predictability and performance. The application of a mediation approach is common in empirical research. Therefore, path analysis and regression equations are common analytic approaches for examining contingency relationships.
Because the current study was designed to explore the relationships between organizational context, structure, and medication errors, the conditions on congruence relationship were not satisfied because only the combination of organizational context and structure was examined. Contingency tests the fit-performance relationship, which was also not the purpose of this study. Therefore, the study used the theoretical constructs of contingency theory only to build the study framework, which is depicted in Figure 1.

**Summary**

Medication errors are a great concern for healthcare systems, and error management and prevention approaches have been widely discussed. Error management refers to a series of actions that include detection, identification, and handling. Error prevention refers to analysis of the sources of errors at micro, meso, and macro levels; the macro level is viewed as a “source of cause” that leads to variations at micro and meso levels. Scholars have recommended that errors should be studied at the macro level rather than the micro level. However, few studies have taken a macro-level approach and these studies have had some methodological weaknesses. Thus, there is little information available to help hospitals improve their safety. Structural contingency theory, which is a macro-level theory, was used in this study. Structural contingency theory was presented in this chapter, and the components of SCT and their theoretical definitions were discussed. Operational definitions and the relationships among variables derived from the components of structural contingency theory are discussed in the next chapter.
Figure 1. Conceptual Framework
CHAPTER II

LITERATURE REVIEW

In this chapter, variables derived from the components of structural contingency theory are presented, and operational definitions and relationships among these variables are discussed. Leatt and Schneck’s (1981, 1982) definition of technology for nursing units was used in the current study. Since the hospitals used in the study were homogeneous in their characteristics, i.e., all were teaching and referral hospitals in an urban area, only internal environmental characteristics were considered, including skill mix, nurse experts, unit size, and type of unit. Professional autonomy, participation in decision making, and formalization make up the practice structure. All of these were examined for associations with medication errors, the outcome used here as a measure of patient safety.

Definitions of each of these variables are given below. For technology and the characteristics of the internal environment, the review focuses first on the relationships between the components of structural contingency theory and medication errors, and then on the practice structure. The review also looks at the relationships between practice structure and medication errors. Finally, the study model is depicted.

Technology

A number of nursing studies have focused on the relationship between technology and structure in nursing care units (Argote, 1982; Leatt & Schneck, 1982; Loveridge, 1988; Zinn, Brannon, Mor, & Barry, 2003). The findings from these studies are consistent: nurses who work in units with a high degree of technology, both inpatient units and emergency units, have found that a low degree of authority is helpful in facilitating their
activities. Leatt and Schneck (1982) explored the relationships between technology, size, environment, and structure in 157 nursing units and found a correlation \( r = -.23; p < .01 \) between technological uncertainty and role specificity, a measure of formalization. The sample in Leatt and Schneck’s study included medical, surgical, intensive care, rehabilitation, psychiatric, obstetrical, and rural subunits; the findings of their study suggested that different type of units had different degrees of technology, and the associations between technology and structure were mixed. Leatt and Schneck, however, studied only congruence relationships, not fit-performance relationships.

Unlike Leatt and Schneck (1982), Alexander and Bauerschmidt (1987) examined the fit-performance relationship and found that high quality of care occurred when instability was negatively related to vertical participation and uncertainty was negatively related to formalization. The small sample \( n = 27 \) units, however, limited the generalizability of these finding. Although the study purposes of Leatt and Schneck (1982) and Alexander and Bauerschmidt (1987) differed, it is worth noting that both studies analyzed data and presented findings based on sub-dimensions or factors; three technology factors were examined: instability, variability, and uncertainty, and two sub-dimensions of formalization were examined: role definition and role specificity.

Zinn et al.’s (2003) study reflected Leatt and Schneck’s finding that patients’ conditions in a unit presented different degrees of technology, which influenced unit structure. They found that psychosocial care was more complex than physical care in nursing, and yet charge nurses gave more autonomy to nurse aides in psychosocial care than in physical care \( t = 9.63; p < .001 \). Although the instruments used to examine organizational structure, centralization and formalization differed in Leatt and Schneck’s (1982) and Zinn et al.’s studies, the conceptualizations of centralization and formalization were similar in the two studies. For instance, Zinn et al. (2003) asked participants whether
written documentation was used to ensure appropriate completion of tasks, and Leatt and Schneck (1982) asked whether nurses perceived that rules and procedures guided nursing practice, as a measure of formalization.

Research on the effects of technology on performance, particularly performance associated with medication errors, is rare. Mark et al. (2003) revised Leatt and Schneck’s (1981) instrument, which was derived from Overton et al.’s (1977) Technology Instrument, and measured the effects of technology on multiple patient outcomes in 124 general medical-surgical nursing units, using hospital level and unit level analyses. A direct negative effect of technology on nurse satisfaction was found, but no direct or indirect relationship was observed between technology and medication errors. In Mark et al.’s study, little variance in medication errors was explained, suggesting that medication errors may not be sensitive to contextual variables.

A final study that explored the effects of technology on performance was conducted by Cox (2003), who surveyed 141 nurses from 13 inpatient units to examine the relationships between technology, work satisfaction, and team performance. A negative correlation ($\beta = -.31; p < .000$) was found between technology and work satisfaction, but no impact of technology on team performance was found. Cox’s study was an individual level study, differing from the other studies reviewed, which used the patient unit as the unit of analysis.

Technology is sometimes viewed as a proxy for patient acuity (Mark et al., 2003), and in general, patient acuity is considered a predictor of the need for staff mix in nursing units (Hall, Doran, & Pink, 2004). When patient conditions become more complex or unanticipated events occur, they have a significant positive influence on nursing hour utilization ($t = 2.94; p = .003$) (Hall et al., 2004). These events or conditions require a nurse to temporarily abandon regular tasks for other patients and deal with the
unanticipated events. Other nurses have to take over as many of the nurse’s treatments and responsibilities as possible to maintain equilibrium in the nursing unit. Nurses not only have to carry out actions rapidly to cope with the crisis, but they also have to make immediate, accurate decisions about priorities. These events are likely to reduce both patient safety outcomes and work satisfaction.

Based on the literature, the relationships between technology, organizational structure, and performance were tested. It was hypothesized that:

Hypothesis 1a (H1a): Technology is positively associated with the rate of medication errors in a nursing unit.

Hypothesis 1b (H1b): Technology is positively associated with the degree of autonomy in a nursing unit.

Hypothesis 1c (H1c): Technology is positively associated with the degree of participation in decision making in a nursing unit.

Hypothesis 1d (H1d): Technology is negatively associated with the degree of formalization in a nursing unit.

**Characteristics of The Internal Environment**

The characteristics of the internal environment examined in the current study included skill mix, nurse experts, unit size, and type of unit.

**Skill Mix**

Medication administration is a key responsibility of nurses in hospitals, and numerous studies have assessed the relationships between nursing skill mix and patient safety issues, especially medication errors (Blegen, Goode, & Reed, 1998; Donaldson et al., 2005; Dunton, Gajewski, Taunton, & Moore, 2004; Hall, et al., 2004; Kendall-Gallagher & Blegen, 2009; Lankshear, Sheldon, & Maynard, 2005). Nursing skill mix refers to the proportion of registered nurses (RNs) in the total unit staff (Aiken,
et al., 1994). Studies conducted in the U.S., the United Kingdom, and Canada have found that RN skill mix on nursing units was inversely related to medication errors (Hall, et al., 2004; Lankshear, et al., 2005; Whitman, Kim, Davidson, Wolf, & Wang, 2002). In a review of 61 international studies conducted after 1990, Lankshear et al. (2005) explored the relationships between nurse staffing and healthcare outcomes, and concluded that the lower the proportion of registered nurses, the higher the number of medication errors in nursing units. In another study of 77 nursing units in 19 teaching hospitals, Hall and colleagues (2004) studied the associations between nurse staffing, nursing hours, and rates of adverse outcomes, including medication errors, patient falls, and wound infections. They found that high rates of medication errors occurred in units with a low proportion of RNs ($r = -3.25; p < .05$).

Thus, while patient acuity has been considered a key factor in increasing medication errors because patients with severe illnesses receive a wide variety of drugs and drugs are administered more frequently (Cullen, et al., 1997), controlling for patient acuity, researchers have found that the proportion of registered nurses was associated with medication errors and mortality rates, and a high proportion of RNs decreased medication errors (Blegen, et al., 1998; Blegen, Vaughn, & Goode, 2001; Whitman, et al., 2002).

In a study of the relationships between total hours of nursing care and patient outcomes in 42 units in a large Midwestern hospital, Blegen, Goode, and Reed (1998) found that the greater the percentage of RNs employed on the units, the larger the number of hours of nursing care used ($r = .59; p < .01$), and the relationship between proportion of RNs and adverse patient outcomes was curvilinear: as nursing units increased the RN proportion, medication events decreased until the RN proportion was 87.5%; then the rate of medication errors increased. When they used the number of doses as the denominator, they found that medical-surgical and obstetric units had the highest rates of medication
errors. In another Blegen study, data from 39 units in 11 hospitals were used to examine the relationships between nurse staffing and patient outcomes. Multiple regression analyses showed a negative relationship between RN proportion and reported medication error rates ($\beta = -.58; p < .01$). The authors also found that as the RN proportion increased from 50% to 85%, the rate of medication errors declined; again, however, once the RN proportion increased over 85%, the medication error rate increased. In this study, patient days were the denominator and the intensive care unit had the highest medication error rate (Blegen & Vaughn, 1998).

The effect of skill mix on unit structure has rarely been explored. The patient care duties of RNs include performing nursing techniques, administering prescribed medications, observing the progress of treatment, detecting deviations from standard care, reporting patients’ conditions to physicians, and observing the physical and emotional stability of patients. All these duties require nurses with the knowledge and skills to collect information, exercise judgment, and make decisions to minimize risk and, on occasion, prevent catastrophic events. In contrast to the duties of RNs, nurse aide or assistant (NA) duties include taking routine vital signs, feeding, doing oral hygiene, and bathing. The duties of NAs tend to be routinized and stable, so autonomy to make decisions regarding the patient’s immediate needs is unnecessary for them. Thus, with a higher proportion of RNs in a nursing unit, a greater degree of professional autonomy is likely.

Based on the literature reviewed above, the relationships between skill mix, medication errors, and professional autonomy were tested in the current study. It was hypothesized that:

Hypothesis 2a (H2a): A higher proportion of RNs in the nursing skill mix is associated with a lower rate of medication errors.
Hypothesis 2b (H2b): A high proportion of RNs in the skill mix is positively related to professional autonomy.

**Nurse Experts**

An expert is an individual who is well trained and educated, has advanced skills, and is rich in clinical knowledge and experience (Henderson-Everhardus, 2004; Zulkowski, Ayello, & Wexler, 2010). Nurse experts have intuition based on advanced clinical knowledge and accumulated experiences with many patients with similar diseases. Many researchers have proposed that years of clinical experience, level of education, and specific training contribute to nurse expertise (Blegen, et al., 2001; Corcoran, 1986; Morrison, Beckmann, Durie, Carless, & Gillies, 2001; Tzeng, 2004; Zulkowski, et al., 2010).

Typically, expert nurses provide higher quality and safer care than non-expert nurses, for several reasons. First, nurse experts have the ability to detect or predict unsafe events early. Sometimes patients’ conditions change rapidly and the changes are unanticipated; nurses with clinical expertise are able to recognize the beginnings of these changes through careful monitoring and observation. When they have an intuition that change has occurred, they may quickly recognize unsafe behaviors or an unsafe environment and thus prevent error occurrence. Further, expert nurses synthesize all the available information and develop a broad picture of the patient’s care prior to making decisions and implementing plans. Expert nurses correlate data on symptoms with possible treatments and the side effects of treatment, while novices usually focus on a single problem for decision-making (Corcoran, 1986). Finally, in addition to possessing the clinical competence to make decisions about patient care, expert nurses serve as tutors for non-expert nurses, who often seek direction as they perform daily activities. This prevents novices from performing uncertain behaviors and committing errors. Hanneman (1996),
who observed and interviewed 27 ICU nurses and 31 ICU patients over a 6-month period, concluded that expert nurses served as catalysts in advancing the practice of non-expert nurses, and expert nurses also had significantly better patient outcomes than non-expert nurses. Thus, a nursing unit with more nurse experts who recognize changes, detect errors, develop and implement a completed plan, and serve as directors to advice novices should experience fewer medication errors.

Non-expert nurses are thought to possess less clinical knowledge and “conventional wisdom” than expert nurses in exercising judgment and in making decision. Non-experts are also unable to develop appropriate nursing plans and care without directions from expert nurses; they tend to lack confidence when they make decisions or implement treatments and seek advice from nurses with more experience (Tibby, Correa-West, Durward, Ferguson, & Murdoch, 2004). Thus, non-expert nurses may work best and feel most comfortable when they obtain direction from expert nurses or other professionals (Scott, 2009; Tranmer, 2005). Manias et al. (2005), for example, observed 12 new graduate nurses using participant observations in medical, surgical, and specialty units as they administered medications to patients. They found that these new graduate nurses were anxious, lacked confidence, and were more likely to follow protocols and specific policies than make judgments. Thus, non-expert nurses may have minimal autonomy needs, and a rule-based or regulation-based practice structure is adequate for them to perform care activities. However, expert nurses may be more productive in a practice structure with less direction (Benner, Benner, Tanner, & Chesla, 1996; Tranmer, 2005). They are able to recognize the unexpected and manage variation, and therefore they need a flexible nursing practice structure in which professional autonomy and participation in decision making are high, and rules and regulations are limited (Scott, 2009).
On the basis of this discussion, the following hypotheses were tested in the current study:

Hypothesis 3a (H3a): The proportion of expert nurses is inversely related to medication errors.

Hypothesis 3b (H3b): The proportion of expert nurses is positively related to the degree of professional autonomy in a nursing unit.

Hypothesis 3c (H3c): The proportion of expert nurses is positively related to the degree of participation in decision making in a nursing unit.

Hypothesis 3d (H3d): The proportion of expert nurses is negatively related to the degree of formalization in a nursing unit.

Unit Size

Size of an organization has been examined as a component of organizational context, and it is a factor that may affect the way organizations design and use management systems (Leatt & Schneck, 1982). As early as 1976, Kimberly pointed out four aspects of size: physical capacity, available personnel, inputs or outputs, and discretionary resources. Scott (1998) noted that size reflects the number of available personnel in many organizations. In health care systems, two common definitions of size are the total number of patient beds (Dunton, et al., 2004; Mark, et al., 2003) and the total number of staff in the unit or hospital (Kalisch & Begeny, 2005).

Relationships between hospital and unit size and patient safety have been discussed by numerous researchers. No relationship has been found between hospital size and medication errors, in either primary or secondary data sets, or observation or self report (Aiken, Clarke, & Cheung, 2003; Barker, Flynn, Pepper, Bates, & Mikeal, 2002; Kanter, Turenne, & Slonim, 2004). For instance, Barker et al. (2002) conducted a prospective cohort study using participant observation to identify the prevalence of medication errors
in 36 health care facilities. They divided hospitals into two types: small \((n = 19)\) and large \((n = 17)\), based on the number of patient beds in the facility, but thus found no relationship between size of facility and error rate \((t = 0.39; p = .68)\). Similarly, Hofman and Mark (2006), who examined the impact of safety climate on multiple organizational outcomes in 81 nursing units in 42 randomly selected hospitals throughout the United States, found that hospital size had no relationship to patient outcomes, including the rate of medication errors \((\beta = -.0007, p > .05)\).

On the other hand, when the analysis was based on the nursing unit, studies have consistently found that unit size was associated with patient safety outcomes. In one survey of nurses in 124 units in 64 general short-term acute care hospitals, a high rate of patient falls was found in large nursing units (Mark et al., 2003). Vogus et al. (2007), who examined the impact of trusted leadership on reported medication errors in 78 nursing units in 10 acute-care hospitals in 5 states, found that the number of patient beds in nursing units was significantly related to reported medication error \((\beta = 1.12; p < .01)\), controlling for RNs’ education level and experience, the patient-to-RN ratio, and unit type.

A study conducted by Valentin et al. (2009) in 113 intensive care units in 27 countries found that unit size affected parenteral medication errors (odds ratio per increase of one bed: 1.01, 1.00 to 1.02). Valentin et al.’s definition of medication errors included errors of omission or commission in the context of parenteral drug administration rather than “Five Rights”. In all error reports, nursing unit size was noted to affect medication errors.

Scholars have concluded that unit size indicates the complexity of the organization and communication, and greater complexity makes a system more prone to error (Kalisch & Begeny, 2005; Leatt & Schneck, 1982; Valentine et al., 2009). Merchant (1984) noted
that unit size growth increases both communication and control problems. Scholars have also concluded that size is related to greater decentralization and structuring of activities because as the information flow increases, the difficulty of maintaining control also increases (Connor, 1992; Daft, 2009). Hage and Aiken (1969) suggested that when organizations grow larger and have more employees, decision-making authority can no longer be held by top-level administrators because they become overloaded. Strict rules and procedures and close supervision are ineffective in controlling employees’ task performance in a large unit (Leifer & Mills, 1996). Managers in large units are unable to supervise every employee’s daily activities; appropriate decentralization and a low degree of formalization are therefore needed for employees to set their own goals, respond to unpredicted changes, make appropriate decisions, and monitor their own performance of tasks.

Based on this discussion, the following hypotheses were tested in the current study:

Hypothesis 4a (H4a): Unit size is positively associated with medication error rates.

Hypothesis 4b (H4b): Unit size is positively related to degree of professional autonomy.

Hypothesis 4c (H4c): Unit size is positively related to degree of participation in decision making.

Hypothesis 4d (H4d): Unit size is inversely related to degree of formalization.

**Type of Unit**

A number of environmental characteristics affect unit structure and outcomes, and type of unit has a prominent role. In nursing, it is thought that intensive care units (ICU) have higher rates of medication errors than non-ICUs because of the environment and the types and frequency of medication use in these units (Cullen, et al., 1997). The ICU is highly technical, and ICU nurses need appropriate training to work effectively with a
variety of devices. Additionally, noises from machines and from multiple providers around patients cause distractions during medication administration (Mrayyan, et al., 2007; Stratton, Blegen, Pepper, & Vaughn, 2004). One survey of nurses in three Taiwanese hospitals found that nurses perceived distractions as causes of medication errors, and 33% of the medication errors reported occurred in ICUs (Tang, et al., 2007). Other studies from the United States, using national samples, also found that distraction and interruption were prominent factors in medication errors. Indeed, distraction was associated with 47% of medication errors (Carlton & Blegen, 2006; Hicks, Cousins, & Williams, 2004; Ulanimo, O'Leary-Kelley, & Connolly, 2007).

Patients in ICUs receive at least twice as many drugs as patients in non-ICUs, increasing the opportunity for medication errors (Valentin et al., 2009). Also, certain types of medications that are often used in ICUs, such as morphine, digoxin, cefazolin, warfarin, vancomycin, meperidine, oxycodone, and acetaminophen, have higher error rates in administration (Cardin, 1994; Classen, Pestotnik, Evans, Lloyd, & Burke, 1997; Cullen, et al., 1997). Cullen et al. (1997) compared the rate of adverse drug events (ADEs) between 5 randomly sampled ICUs and 6 randomly sampled general units and found that ICUs had nearly twice as many ADEs as non-ICUs (19 events vs 10 events per 1000 patient days, p<.05). However, patients in ICUs received a wider variety and larger number of drugs, and when the researchers adjusted for the number of drugs used, they found no difference between ICUs and non-ICUs in the rate of ADEs.

Type of unit is also a major factor in the distribution of authority in nursing units. Nurses in ICUs require a higher degree of autonomy than those in non-ICUs because of the severity of patients’ conditions in the ICU. ICU patients require high level technical devices, such as ventilators, for treatment. Increases in the complexity of care have been found to be related to increased need for nurses’ decision-making. Cardin (1994) noted
that horizontal authority in an ICU allows more individual control of practice and resources and positively influences nursing care. Rapid changes in patient conditions and unanticipated demands require nurses to respond promptly. When these challenges occur, nurses need the authority to prioritize high frequency standing orders or complex protocols. Morrison (2001) suggested that managers should authorize nurses to make patient care decisions and respond in a timely manner to changes in a patient’s condition in order to ensure patient safety. Using the Nursing Authority and Autonomy Scale (NAAS). Blanchfield and Biordi (1996) compared nurse leaders’ and staffs’ perceptions of nurses’ authority and autonomy to deliver patient care. They concluded that nurses who work in an ICU perceive a higher level of autonomy than those working in other specialty units. Blanchfield and Biordi’s (1996) study also addressed individual perceptions of nurses’ authority and autonomy.

Thus, the following hypotheses were tested in the current study:

Hypothesis 5a (H5a): The rate of medication errors is significantly higher in ICUs than in non-ICUs.

Hypothesis 5b (H5b): The degree of professional autonomy is significantly higher in ICUs than in non-ICUs.

Practice Structure

Practice structure includes three variables: autonomy, participation in decision making, and formalization. These variables are discussed below.

Autonomy

Autonomy is generally defined as the degree of authority to make decisions regarding one’s practice. Autonomy is believed to be an important component of the professional nurse environment (Aiken et al., 1994). The prevailing view is that autonomy is desired and of benefit to nurses, patients, managers, and even hospitals. The
IOM (2004) recommends that hospitals give staff a high level of autonomy so that they are able to use their professional competencies to make decisions for clients and units. Much has been written about the relationships between professional autonomy and job satisfaction, retention, and turnover (Andrews & Dziegielewski, 2005; Currie, Harvey, West, McKenna, & Keeney, 2005; Rafferty, Ball, & Aiken, 2001). Laschinger et al. (2001), who investigated the effects of professional autonomy on job satisfaction of 3016 nurses in 135 hospitals, found that professional autonomy had no direct effect on job satisfaction and organizational trust. However, a study of 305 clinical nurses and 16 nurse leaders recruited from two magnet and two non-magnet hospitals, found that autonomy was a significant positive predictor of nurses’ job satisfaction, and nurses in magnet hospitals reported a higher degree of autonomy ($t = 7.24; p < .001$) and control over their practice ($t = 8.16; p < .001$) than nurses in non-magnet hospitals (Upenieks, 2003).

Unfortunately, low response rates (44%) and low willingness of hospitals to participate in the study decreased the representation. Also, these studies looked at the individual level rather than the unit or organizational level.

Aiken’s studies conducted in magnet hospitals found that autonomous practice was inversely related to adverse patient outcomes, especially mortality (Aiken, Clarke, Sloane, Sochalski, & Siber, 2002; Aiken, et al., 1998; Aiken, et al., 1994). Recent studies that examined the professional practice environment, including autonomy, participation, and nurse-physician collaboration, as a predictor of patient safety issues (e.g., medication errors, patient falls) found no significant relationship between the professional practice environment and patient safety outcomes (Mark et al., 2003, 2008). Studies of the effects of practice autonomy on patient safety are rare. However, scholars have proposed that hospitals with an autonomous work environment enable nurses to provide safer patient care (Kramer & Schmalenberg, 2003; Laschinger, et al., 2001). That is, when nurses
perceive that they have autonomy in their work environment, they perceive support, trust, and respect from superiors, which may enhance their confidence, communication, cooperation, and shared decision making, and optimize the coordination of patient care -- keys to high-quality, safe, and cost-effective patient care (Laschinger, et al., 2001; Norsen, Opladen, & Quinn, 1995; Stein, Watts, & Howell, 1990).

Based on this discussion, the following hypothesis was tested:

Hypothesis 6 (H6): Professional autonomy is inversely related to medication errors.

**Participation in Decision Making**

As mentioned above, participation in decision making is another dimension of autonomy, indicating the degree of authority of employees to make administrative decisions regarding their practice.

The IOM has noted that horizontal communication and empowerment of the members of the healthcare team to participate in decisions that affect their work processes are determinants of patient safety (Page, 2004). And, there is some evidence that participation in decision-making on administrative matters affects nurses’ work processes and, in turn, improves patient safety outcomes (Page, 2004). Participation in decision making influences patient safety activities in two ways, through the perception of environmental control and through information flow. A hospital is a profession-oriented and hierarchical organization (Gifford, Zammuto, Goodman, & Hill, 2002). Participation in decision-making increases employees’ perceptions of controlling the environment, because participation not only signifies the power of the profession but also indicates respect for employees (Brooks & Zeitz, 1999). When employees participate in decision making, they tend to believe that they can control environmental uncertainty and handle risks from the task; further, frustration and stress from the task are decreased (Jackson, 1983). Elfering et al. (2006), who examined the links between workplace stress and
patientsafety-related incidents using self-observation in 23 nurses over a period of 2
working weeks, found that 62 stressful events were related to patient safety and 21%
(13/62) of the patient safety events were medication events. Perceptions of lower job
control predicted the occurrence of these adverse events. Dugan et al. (1996) used data
obtained from 239 nurses (response rate = 49%) to examine the effects of nurses’ stress
on patient outcomes and found a relationship between stress and medication errors ($\gamma$
= .40; $p < .05$). Nurses have also been found to perceive that lack of control of the work
environment contributes to greater medication errors (Mayo & Duncan, 2004; Osborne,
Blais, & Hayes, 1999).

Professionals make better administrative decisions and have better organizational
performance when the quantity and quality of information are greater (Anderson, et al.,
2003; Ketchen, Thomas, & McDaniel, 1996). Frontline staff are in a position to recognize
the nature of systems and observe the needs of patients; therefore, when they are
authorized to participate in decision making, they can help their unit best meet its needs
(McDaniel Jr, 1997). For instance, nurses’ opinions on incorporating new technologies
such as computerized physician order entry and infusion pumps have been found effective
in preventing medication errors (Ball, Weaver, & Abbott, 2003).

The above discussion provided the foundation for the following hypothesis:

Hypothesis 7 (H7): Participation in decision making is negatively associated with the
rate of medication errors in a nursing unit.

**Formalization**

Formalization refers to the use of formal written documents that present the rights
and duties of employees, including policies, job descriptions, procedures for hiring and
firing of employees, requirements of employees, rules, procedures, and instructions to
ensure desired performance in the practice setting (Hage & Aiken, 1969).
According to empirical studies (Craven et al., 1993; Hartline, Macham, & Mckee, 2000), the impact of formalization on organization is bipolar. On the one hand, formalization implies that employees have to follow specific rules or procedures which force the employees to change behaviors or habits they are used to. Formalization sets forth the stages in standardizing tasks, which means that the variety and difficulty of tasks are reduced and tasks become simplified. In production-oriented industries, formalization provides rigid work rules that show clear expectations, clarify divergent interpretations of tasks, and decrease confusion for employees. In other words, formalization provides a guideline to problem solving. For instance, Cravens et al. (1993) noted that formalization reduces role ambiguity and conflict and creates a transparent working culture that enhances organizational commitment and efficiency. However, boring, repetitive jobs prevent employee creativity (Hartline, Maxham, & Mckee, 2000), and the consequence is low employee morale and little satisfaction.

The impact of formalization on organizational performance is controversial. Michaels et al. (1988) looked at whether formalization influenced organizational commitment and work alienation through role ambiguity and role conflict. Data were obtained from 215 salespeople, and the results showed a significant correlation of formalization with organizational commitment ($r = .32; p < .01$). The authors concluded that formalization reduced role stress so that organizational commitment was increased. In another study, data were obtained from 101 (52%) directors of quality improvement to explore factors that affected the effectiveness of Total Quality Management in hospitals. The study found that the effectiveness of Total Quality Management increased because of greater process ($r = .17; p < .05$) and behavior control ($r = .54; p < .05$) (Douglas & Judge, 2001). However, Kakabadse (1986), who investigated the relationships between aspects of organizational structure and performance in 9 social services organizations, found an
inverse relationship between formalization and organizational performance: formalized procedures and control generated powerlessness ($r = .29; p < .05$), lack of interest in the job ($r = -.23; p < .05$), and loss of enthusiasm ($r = -.32; p < .05$), which led to deviant behavior and increased negligence. Similar results were reported by Matheson (2007). Thus, studies of formalization have produced mixed results in business and management disciplines.

Formalization is rarely included in nursing studies, especially in acute care hospitals. In one of the few studies, Anderson, Issel, and McDaniel (2003) found that formalization of practices in 164 nursing homes, which were characterized as unskilled or semiskilled, had effects on resident outcomes, e.g., complications of immobility ($\beta = .29; p < .05$).

Although a nursing unit in a hospital is a dynamic and high intensity environment with a highly skilled workforce, and nurses on the unit must be encouraged to think and act in the creative ways that characterize a non-formalized structure, the process of administering medication is viewed as a rigid task and nurses’ behavior must not deviate from the protocol for administering medication. Goldspiel and associates (2000) reported that the number of chemotherapy-related medication errors decreased after protocol development and computer-system enhancement.

Based on this literature, the following hypothesis was tested:

Hypothesis 8 (H8): Formalization is negatively related to medication errors in a nursing unit.

Summary

This chapter has hypothesized the relationships among variables derived from the theoretical framework presented in Chapter 1. Technology and the characteristics of the internal environment are expected to be associated with both practice structure and medication errors, and variables of practice structure are expected to show connections
with medication errors. Based on the hypotheses presented in this chapter, Figure 2 depicts a brief operational framework used in the current study.

Figure 2. Framework for the Current Study.
CHAPTER III

METHODOLOGY

The current study was designed to examine the associations among technology, environmental characteristics, practice structure, and medication error rates in nursing units in Taiwan. This chapter includes the design, setting, sample, measurement of research variables, and statistical analysis. The analysis was conducted in three phases. The first phase examined the semantic equivalence of the translation – back translation versions of the Technology Instrument, the content validity of the Chinese version of Unit Technology Instrument, and the reliability of each instrument. Phase I also included a preliminary test that provided some information on validity for both the Unit Technology Instrument and the Attitude on Participation Scale. In Phase II, data were aggregated from the individual to the unit level. The final phase examined the relationships among study variables using Pearson’s Product Moment (PPM) correlations and t-tests.

Design

This study used a cross-sectional design with self-administered questionnaires. The cross-sectional design is economical and is appropriate for examining relationships among phenomena at a particular time (Polit & Beck, 2004). Questionnaires were distributed to staff in 65 nursing units in three hospitals. Dillman’s (2007) Tailored Design Method was used for data collection, and two rounds of survey distribution occurred. The study period was 3 weeks during Winter 2010.
Settings

Three hospitals, including two local hospitals and one medical center, were recruited. All three were teaching and referral hospitals. St. Martin De Porres Hospital, located in the northern part of southern Taiwan, is a local, private Catholic hospital with 611 patient beds. Yuan’s General Hospital, with 644 patient beds, is located in the southern part of southern Taiwan. Chi-Mei Medical Center, which is located in the middle part of southern Taiwan, has 1267 patient beds and focuses on providing cancer and trauma care. All three hospitals used the four-level clinical ladder system established by the Taiwan Nurses Association. This ensured that the hospitals selected used the same definition of study variables, such as nursing experts (a classification in the clinical nursing ladder system). The nursing units in these three hospitals were used for the study.

Sample

Since the study focused on relationships between the environment, structure, and medication errors in inpatient units, outpatient units, the delivery room, operating rooms, and emergency departments were excluded. The number of eligible units was 65.

All of the registered nurses and head nurses who worked in these 65 units, a total of 1,300 nurses and 65 head nurses, were invited to participate in the study. Directors, supervisors, and nursing assistants were excluded because they do not participate in directly administering medications to patients. According to calculations of the G*Power software (Faul, Erdfelder, Buchner, & Lang, 2009), the sample size needed was 42 units with power .95; α = .05. Thus 65 units were more than the number actually needed.

Variables and Their Measurement

Operational definitions, instruments used to measure the variables, and data sources are given below.
Technology

Technology was defined as the complexity of nursing care due to nurses’ tasks. No instrument written in the Chinese language was found to measure technology, so Leatt and Schneck’s (1981) technology instrument and Mark et al.’s (2003) revision of Leatt and Schneck’s (1981) technology instrument, were revised and translated for this study. As noted in Chapter 1, a nursing version of the technology instrument was initially published by Overton, Schneck, and Hazlett (1977). Overtone and her colleagues developed the instrument based on Perrow’s (1976) conceptual framework, but the method of developing and selecting items was not described. Three hundred fifty-five nurses were invited to participate in their study, and 340 returned the questionnaire. Factor analysis identified three technological factors: uncertainty, instability, and variability. Leatt and Schneck (1981) replicated Overton et al.’s instrument and tested it using 1,265 nurses from 157 nursing units in 24 hospitals; factor analysis also yielded three factors, which were similar to the three factors produced by Overton et al. and also reflected the constructs hypothesized by Perrow (1967). Therefore, Leatt and Schneck (1981) concluded that their findings indicated considerable construct validity for the measure of nursing technology. Leatt and Schneck also compared the rankings and mean scores of the three technological factors in different types of units with Overton et al.’s findings, and the results were similar. This provided evidence for generalizability to other nursing studies. Reliability of the instrument was not described in Leatt and Schneck’s study. In subsequent use, reliability coefficients for instability, variability, and uncertainty ranged from 0.77 to 0.86 (Alexander & Bauerschmidt, 1987). Leatt and Schneck’s instrument is a 21-item scale.

Mark and associates revised Leatt and Schneck’s technology instrument for application to nursing units. Mark et al.’s (2003) instrument consists of 14 items with 5
response categories from 1 (few) to 5 (most) to allow staff nurses to rank the complexity of patient needs. Exploratory factor analysis yielded three factors: problem-solving, rapid and unpredictable change, and requirement for technical equipment. Together these three factors explained 48% of the total variance in technology. Internal consistency reliability was 0.76 for the entire instrument, but the reliability for each factor was not noted. To distinguish Mark et al.’s instrument from Leatt and Schneck’s technology instrument, patient technology, a term used in Mark et al.’s study, was used for Mark et al.’s instrument.

To examine the impact of the complexity of nursing care on unit structure in Taiwanese nursing units, the instrument was revised and translated for use by head nurses. For instance, “What percentage of the time are you asked to provide treatment that you are not familiar with?” was revised to “How many of the procedures or treatments asked for are seldom provided by your unit?” The sentence “on your shift” was also replaced by “on your unit.” In addition, given the different culture and era, some items were deleted based on the researcher’s experiences and understanding of nursing practice in Taiwanese nursing units. For instance, “What percentage of the patients have written goals for their individualized care in the Kardex?” was not an appropriate item because the Kardex is not used in Taiwanese nursing units. Finally, five response options (e.g., none, few, half, most, and all) were used to ensure that head nurses answered the questions based on the general situation rather than a particular shift or day. The revised instrument consisted of 16 items with a 5-point scale ranging from 1 (none) to 5 (all).

In this study, Brislin’s translation - back translation approach was used to establish semantic and content equivalence of the translation - back translation versions of the instrument (Brislin, 1970, 1986). Two bilingual translators, one with a master’s and one with a doctoral degree in nursing, were asked to translate the instrument from English to
Chinese. The Chinese version of the instrument then was reviewed by a Chinese monolingual reviewer so that incomprehensible or ambiguous words could be identified. In a third stage, the Chinese version of the instrument was back-translated by two new bilingual translators who were unfamiliar with the original English instrument.

After the translation-back translation process, five native English speakers were invited to examine the differences between the two versions of the English scale. Item to item agreement between the two versions was analyzed using Kendall’s W test. For the current study, the Chinese version of the technology instrument was titled the “Unit Technology Instrument”.

**Skill Mix**

Nursing skill mix refers to the ratio of registered nurses (RNs) to the total nursing staff in a nursing unit, including full- and part-time staff (Aiken et al., 1994). There are two types of nursing employees in Taiwanese hospitals: registered nurses and unlicensed assistant personnel. Registered nurses are responsible for providing patient care. Skill mix was calculated by dividing the number of registered nurses by the total nursing staff on the unit.

**Nurse Experts**

Operational definitions of a nurse expert are inconsistent. Researchers have noted that years of clinical experience, level of education, leadership position, and specific training all contribute to nurse expertise (Blegen et al., 1992; Corcoran, 1986; Morrison, et al., 2001; Tzeng, 2004; Zulkowski, et al., 2010).

The four-level nursing clinical ladder system is used to classify nursing competence in Taiwan, and it has been implemented in more than 100 Taiwan hospitals since 1982. The four-level clinical ladder system includes N1 (novice, in charge of performing general patient care); N2 (advanced beginner, in charge of critical patient care); N3 (competent,
in charge of integrated nursing care and clinical teaching); and N4 (proficient, in charge
of nursing administration and participation in nursing research) (Taiwan Nurses
Association, 2009). The criteria for rising in rank or level include hours of continuing
education, years of work experience, hours of patient education, hours of mentoring
students or novices, ability to complete a study or publication, and hours of advanced
patient care training (Taiwan Nurses Association, 2009). In this study, nurse experts were
measured as the percentage of nurses on the staff in a nursing unit who were at N3 or N4.

**Unit Size**

Unit size was defined as the number of patient beds on a unit.

**Type of Unit**

The type of unit was the unit registered to the Department of Health, Executive Yuan,
Taiwan. Types of units included intensive care units (ICUs) and general units. The
intensive care unit was defined as a nursing unit providing continuous care to acutely ill
patients (Medical Dictionary, 2011). In this study, ICUs included all surgical, medical,
pediatric, coronary, and burn care units. A general unit was defined as a nursing unit
providing continuous surveillance and care to non-acutely ill patients. In this study,
general units included general medical, pediatric, respiratory care, hospice care units, and
sick baby rooms.

**Autonomy**

Autonomy was measured using Cheng’s Professional Autonomy Scale. Cheng (1995)
developed this scale by modifying the Pankratz Nursing Questionnaire (PNQ) and the
Professional Nursing Autonomy Scale (PNAS). The PNQ was originally developed to
measure the professional autonomy of individual nurses (Pankratz & Pankratz, 1974). It
includes nursing autonomy and advocacy, patients’ rights, and rejection of traditional role
limitations (Miyashita et al., 2007; Pankratz & Pankratz, 1974). The PNAS was
developed by Schutzenhofer (1987, 1988) to measure personal and professional autonomy.

Since the two instruments were developed over 20 years ago and some items did not reflect Taiwanese cultural characteristics, Cheng (1995) developed an autonomy instrument by using experts, including professors, head nurses, nurse specialists, and clinical instructors, to select items from the PNQ and PNAS that were related to autonomy concepts. Eleven items were selected that characterized high self-control nursing activities. To complete the scale, nurses rated the degree of their autonomy based on their experience in carrying out daily activities.

Construct validity was established using the contrasted-groups approach; two nurse groups (nurses in surgical intensive care units and nurses in maternity units were compared on their degree of autonomy. Although Cheng’s decision to use these two units was unclear, t tests showed significant differences ($p < .001$) between the ICU and the maternity units after controlling for participants’ gender, age, education, income, and years of working experience. Nurses in ICUs reported a higher degree of autonomy than nurses in maternity units. The scale also had acceptable internal consistency reliability (Cronbach’s alpha = 0.79). When the internal consistency reliability of Cheng’s scale was tested again, reliability was $\alpha = 0.71$ in the pre-test and $\alpha = 0.76$ in the following test (Li, Li, Yin, & Wu, 2002). Cheng’s Professional Autonomy Scale has 11 items, and it is responded to using a 4-point scale ranging from 1 (never) to 4 (always).

**Participation in Decision Making**

Participation in decision-making refers to nurses’ perception of their involvement in decisions related to administrative issues and unit development. Slate and Vogel’s Attitudes on Participation Scale (Slate & Risdon, 1997; Slate, Vogel, & Johnson, 2001), translated into Chinese by Huang (2004), was used to examine the degree of participation...
in decision-making in the nursing units in this study. Slate and Vogel’s scale was developed and refined on the basis of the literature. Employees in a private, minimum security correctional institution were used to examine the instrument; 147 employees completed and returned questionnaires. Two subscales emerged from the survey: attitudes toward participation (5 items) and the atmosphere for participation (7 items). These two subscales themselves appeared to not have been empirically derived. The reliability coefficient of the attitudes subscale was .81, and the reliability coefficient on the atmosphere subscale was .85 (Slate & Vogel, 1997). No assessment of the validity of this instrument has been found, even in additional studies conducted by Slate and associates (2003).

In 2004, Huang translated this scale into Chinese. She used a translation-back translation process in which two graduate students who had majored in English translated the instrument from English to Chinese and three other students did back translations. Two visiting scholars at a Taiwanese university who were native English speakers were invited to compare the original version and the back-translated version of the instrument for linguistic congruence. The findings on linguistic congruence were not presented in Huang’s article.

To ensure appropriate use of this instrument in nursing units, Huang substituted “head nurse” for “manager” and substituted “nurse” for “employee” and “worker.” Seven nursing experts, including head nurses, clinical instructors, and clinical nurses who had a master’s degree and an average of 8.5 years of clinical experience, were invited to rate content validity using a 4-point rating scale. The range of the Content Validity Index (CVI) was from .85 to 1.0, and the average was .94. With data from 166 nurses, the Attitudes subscale demonstrated internal consistency reliability of .79, and the Atmosphere subscale reliability was .85. This instrument has a 5-point response scale
from 1 (Strongly disagree) to 5 (Strongly agree) (Appendix 3, Part 3). No assessment of the validity of the instrument was found. A preliminary examination of validity was therefore done in this study.

**Formalization**

Formalization, or the degree to which nurses experience restrictions from management rules and regulations while they are carrying out daily activities, was measured using John’s instrument (1984), which measures the characteristics of the organizational structure. The instrument was developed based on the literature and employees’ and managers’ experiences of restrictions in daily practice in their organizations. The process of item selection was not described in their study. Marketing doctoral students were invited as experts to assess the face validity of the items, and a group of 12 industry personnel were invited to examine content validity. If more than one expert indicated that an item did not have content validity, it was deleted. The final instrument contained 11 items and used a 5-point response scale ranging from 1 (strongly disagree) to 5 (strongly agree) (John, 1984; John & Martin, 1984). To assess discriminant validity, the authors examined the correlation with Aiken and Hage’s (1969) scale, which measures organizational structure. The correlation between the two scales was $\gamma = 0.09 (p = .25)$. Thus, John’s Authority Instrument measures concepts distinct from the concepts of organizational structure in Aiken and Hage’s (1969) scale.

The instrument was translated into Chinese by Lo (2009) and revised to avoid unfamiliar and inappropriate wording for Taiwanese culture and organizations. Although Lo noted that experts were invited to edit inappropriate wording and confirm the context of the scale, the translation process and semantic and content equivalence of the translation instrument were not explicitly noted. Three managers were invited to assess content validity. If more than one manager indicated a lack of content validity for an item,
it was deleted. No item had to be deleted, and the CVI was .91. Exploratory factor analysis (EFA) revealed two factors. Factor 1 (Centralization) accounted for 37% of the variance and included 4 items. Factor 2 (Formalization) accounted for 14% of the variance and included 6 items. After factor analysis, 1 item was deleted because of a low factor loading, and 10 items were retained in the Chinese version. Cronbach’s alpha were 0.70 for Factor 1 and 0.78 for Factor 2 (Lo, 2009).

**Medication Errors**

“Five Rights” provide the basic guideline for nurses to prevent medication errors in hospitals. The “Five Rights” are right patient, right drug, right dose, right route, and right time. In recent literature, the “Five Rights” have been commonly used as a standard for measuring medication administration errors (Fogarty & McKeon, 2006; Hofmann & Mark, 2006; Mark, et al., 2008). In this study, the rate of medication administration errors was measured as the monthly number of medication errors divided by total patient days. Patient days were calculated by summing the total days of all patients’ hospitalizations for a nursing unit during a single month. These data were included in the Unit Data supplied by head nurses.

Table 1 provides a summary of the variables.

**Data Collection**

Participants in the current study included staff nurses (hereafter referred to as registered nurses) and head nurses; the data collection process as for these participants are described separately below.

**Staff Nurses**

Dillman’s (2007) Tailored Design Method was used for data collection. The process included five stages. First, a flyer announcing the need for this study was sent to each nurse’s personal mailbox, usually located on the nursing unit. Two days later, the survey
<table>
<thead>
<tr>
<th>Constructs</th>
<th>Factors</th>
<th>Definition</th>
<th>Instrument and Measurement</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Technology</td>
<td>Complexity of patient care provided by a nursing unit</td>
<td>Unit Technology Instrument revised and translated by the researcher from Leatt and Schneck’s (1981) and Mark et al.’s (2003) instrument</td>
<td>Head nurses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number of RNs/total staff on a unit</td>
<td>Head nurses</td>
</tr>
<tr>
<td>Nursing Unit Environment</td>
<td>Skill mix</td>
<td>Percentage of RNs in a unit</td>
<td>Number of RNs at level N3 and N4 / total staff in a unit</td>
<td>Head nurses</td>
</tr>
<tr>
<td></td>
<td>Nurse Experts</td>
<td>RNs at level N3 or N4 in the unit</td>
<td>Number of RNs at level N3 and N4 / total staff in a unit</td>
<td>Head nurses</td>
</tr>
<tr>
<td></td>
<td>Unit size</td>
<td>Total number of patient beds in a unit</td>
<td>Number of patient beds reported by head nurse</td>
<td>Head nurses</td>
</tr>
<tr>
<td></td>
<td>Type of unit</td>
<td>Type of unit registered with the Department of Health</td>
<td>Type of nursing unit, either general unit or ICU</td>
<td>Head nurses</td>
</tr>
<tr>
<td>Professional Nursing Structure</td>
<td>Autonomy</td>
<td>Degree to which the nurse is able to make decisions regarding patient care</td>
<td>Cheng’s Professional Autonomy Scale (1995)</td>
<td>Staff nurses</td>
</tr>
<tr>
<td></td>
<td>Participation in decision making</td>
<td>Degree to which the nurse is able to make decisions regarding administrative issues</td>
<td>Slate and associates’ Attitudes on Participation Scale (1997 &amp; 2001), translated by Huang (2004)</td>
<td>Staff nurses</td>
</tr>
<tr>
<td></td>
<td>Formalization</td>
<td>Degree of restriction experienced from rules and regulations related to management or administration</td>
<td>John’s Authority Instrument (1984), translated by Leo (2009)</td>
<td>Staff nurses</td>
</tr>
<tr>
<td>Patient Safety Performance</td>
<td>Medication errors</td>
<td>Medication administration violations of “Five Rights”</td>
<td>(Number of medication errors/monthly patient days per month) × 100</td>
<td>Head nurses</td>
</tr>
</tbody>
</table>
package was sent to all potential participants. The survey package included a consent form (Appendix 2), the questionnaires, and a reply envelope. Information on the study purpose and methods, and the participant’s right to confidentiality, anonymity, and withdrawal from the study, was included in the consent form. The researcher’s contact information was also included. The postage for the reply envelope was prepaid. After filling out the questionnaires, participants returned the questionnaires by mail without the consent form. Return of the completed questionnaire connoted their consent to be a participant in this study.

A reminder flyer was sent to all participants on the third day after distribution of the initial survey package, and a duplicate survey package and a consent form with reminder information was sent to all potential participants 3 days after the first reminder flyer. The reminder information included an appreciation and an apology for any inconvenience to participants who had already returned the questionnaire, and a note on the importance of nurses’ participation in the study. Finally, a last flyer with a note of appreciation for their willingness to consider participation and a reminder of the closing date of the study was sent to potential participants. Data collection closed at the end of the third week.

**Head Nurses**

Data on technology, the internal environment, and medication errors were collected from head nurses. A short announcement about the study purpose and the data collection process was made in the monthly head nurse meeting. The survey package, which included a consent form (Appendix 2), unit data collected through the technology instrument, and a reply envelope, was sent to each head nurse by the researcher (Appendix 4, Parts 1-3). The data collection process was the same as for staff nurses. This process is depicted in Figure 3.
Figure 3. Data Collection Process

Week 1

Initial paper flyer to nurses (1 day)

Oral announcement to head nurses (1 day)

Week 2

The first survey package (1 day)

Second paper flyer for following (1 day)

The second survey package (1 day)

Final follow-up paper flyer (1 day)

Week 3

Closed Study (1 day)
Data Analysis

Data analysis consisted of three phases, from examining the semantic equivalence of two versions of the Technology Instrument to hypothesis testing.

Phase I: Instrument Assessment

Phase I, the first step, was to examine item-to-item agreement to determine semantic equivalence of the translation and back translation versions of the Technology Instrument. Five native English speakers were invited to rate semantic equivalence on a 3-point scale: 1 (different meanings between the two versions); 2 (similar meanings), or 3 (same meaning); then Kendall’s W test was used. The second step was to examine the content validity of the Unit Technology Instrument. Five head nurses were invited to evaluate content validity. A 4-point ordinal rating scale was used to judge content validity (1 = not relevant; 2 = unable to assess or in need of so much revision that it would no longer be relevant; 3 = relevant but needs minor revision; and 4 = very relevant) (Lynn, 1986). The content validity index (CVI) was calculated as the proportion of head nurses who rated each item a 3 or 4; the CVI for the total instrument was calculated as the proportion of total items judged a 3 or 4. If the CVI for an item was less than .80, the item was discarded (Knapp, 1985; Lynn, 1986).

Finally, the reliability of each instrument was computed. Since validity information on the Unit Technology Instrument and the Attitudes on Participation Scale was not found, correlations between these two instruments were examined as an initial test of discriminant validity.

Phase II: Data Aggregation

In Phase II, data that were marked as individual-level, including autonomy, participation in decision making, and formalization, were aggregated to the group/unit-level. Researchers recommend the eta-squared ($\eta^2$) coefficient and F ratio to
demonstrate agreement for reliability of aggregation, and $r_{wg}$ to verify inter-item consistency (Forbes & Taunton, 1994; Hughes & Anderson, 1994). The $\eta^2$ coefficient is derived from the between-groups sum of squares ($SS_b$) divided by the total sum of squares ($SS_t$). The equation of the $\eta^2$ coefficient is:

$$\eta^2 = \frac{SS_b}{SS_t}$$

Hughes and Anderson (1994) recommended using the $\eta^2$ coefficient in studies with homogeneous samples because between-groups variance has a great effect on the $\eta^2$ coefficient. Values for the $\eta^2$ coefficient can range from 0 to 1. A high $\eta^2$ coefficient indicates greater between-group variance and less within-group variance. Georgopoloulos (1986) suggested that it is appropriate to refer to the group/unit level from the individual level if the criterion of the $\eta^2$ coefficient exceeds .20. Shortell et al. (1991) suggested that if the $F$ ratio is less than .05, this indicates significantly more between-group than within-group variance. For meaningful interpretation of perceptual agreement for reliability of aggregation, researchers have suggested that the $\eta^2$ coefficient and $F$ ratio should be examined concurrently, because the $\eta^2$ coefficient could be negative when the within-group variance exceeds the between-groups variance (Hughes & Anderson, 1994).

To verify within-group agreement ($r_{wg}$), the method developed and assessed by James, Demaree, and Wolf (1993) was used to assess the consistency within a group. There is no consensus among researchers about the degree of within-group agreement that should be used. However, the research literature suggests that a value equal to .70 or greater for the $r_{wg}$ justifies aggregation of the data to the group level (James, et al., 1993; Lindell, Brandt, & Whitney, 1999).
Phase III: Hypothesis Testing

To test the relationships between technology, environmental characteristics, practice structure, and medication error rates in nursing units, the $t$ test was used to compare the medication error rates in intensive care and general units; the other hypotheses were tested using Pearson’s Product Moment (PPM) correlation coefficients. The conventional level of $\alpha < .05$ was used to represent statistical significance. SPSS 17.0 was used for all analyses.

Institutional Review Board (IRB)

The study was reviewed and approved by the Institutional Review Board (IRB) of the University of North Carolina at Chapel Hill. The IRBs of the three study hospitals approved the study.
CHAPTER IV

RESULTS

This chapter includes the demographics of participants, unit data, and the three analysis phases. Demographics include nurses’ and head nurses’ characteristics. Unit data obtained from head nurses is presented based on three groups: intensive care units, general units, and total units. Phase I of the analysis presents the examination of the consistency of the translated-back translated English versions and the content validity assessment of the Unit Technology Instrument. The reliability of each instrument in the study and preliminary examination of discriminant validity for both the Unit Technology Instrument and the Attitudes on Participation Scale are also included. Tests of the adequacy of aggregating individual data to the unit level are also presented. Finally, the results from the correlations and comparisons are presented to address the relationships between medication error rates and variables derived from the nursing unit environment and practice structure.

Demographics of Participants

Data collected for the study consisted of individual level and unit level data obtained from both registered nurses and head nurses. The demographics of the registered nurse and head nurse participants are summarized below.

Staff Nurses

The survey was distributed to 1,354 nurses, and 1,040 respondents completed and returned questionnaires, for a response rate of 77%. Since two head nurses did not return the questionnaire, the nurse questionnaires returned from these two units (n = 35) were
dropped from the analysis. During data entry, 28 incomplete questionnaires were found and these were also dropped from the analysis. Thus, a total of 977 respondents (72%) were included in the final analysis. The registered nurses were predominantly female (99%), and their average age was 28.4 years ($SD = 4.48$), with an average of 5.2 years ($SD = 4.37$) of employment in their current hospital. More characteristics of the registered nurse participants are presented in Table 2.

**Head Nurses**

Data were obtained from participants in three hospitals in southern Taiwan. A total of 64 head nurses received the survey package, and 62 completed and returned questionnaires. Two respondents, one from an ICU and one from a general unit in the same medical center, did not complete the questionnaire. The response rate was 96.9%. The sixty-two respondents were primarily female, with an average age of 38.9 years ($SD = 6.4$). These head nurses had an average of 17.7 years of licensure as a nurse and 16.5 years of employment at their hospital ($SD = 6.51$). Sixty-one (98%) of the head nurses had at least a bachelor’s degree. More information on the head nurses is presented in Table 3.

**Unit Data**

Unit data were collected for intensive care and general units. As shown in Table 4, the average number of registered nurses working in a unit was 21 ($SD = 11.83$), and the average number of nurse assistants was 1.1 ($SD = 1.0$). The average number of nurses at N3 and N4 was 6.1 ($SD = 6.5$), and the average number of patient beds was 34.3 ($SD = 21.0$).
Table 2. Demographic Characteristics of Staff Nurses ($n = 977$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>1.1</td>
</tr>
<tr>
<td>Female</td>
<td>966</td>
<td>98.9</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td>7</td>
<td>0.7</td>
</tr>
<tr>
<td>Full time</td>
<td>970</td>
<td>99.3</td>
</tr>
<tr>
<td><strong>Type of Unit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive Care Unit</td>
<td>382</td>
<td>39.1</td>
</tr>
<tr>
<td>General Unit</td>
<td>595</td>
<td>60.9</td>
</tr>
<tr>
<td><strong>Clinical Ladder System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1 (Novice)</td>
<td>365</td>
<td>37.4</td>
</tr>
<tr>
<td>N2 (Advanced beginner)</td>
<td>351</td>
<td>35.9</td>
</tr>
<tr>
<td>N3 (Competent)</td>
<td>198</td>
<td>20.3</td>
</tr>
<tr>
<td>N4 (Proficient)</td>
<td>63</td>
<td>6.4</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate degree</td>
<td>193</td>
<td>19.8</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>778</td>
<td>79.6</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>6</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Table 3. Demographic Characteristics of Head Nurses ($n = 62$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Hospital</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical center</td>
<td>27</td>
<td>43.5</td>
</tr>
<tr>
<td>Local hospital</td>
<td>35</td>
<td>56.4</td>
</tr>
<tr>
<td><strong>Type of Unit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive Care Unit</td>
<td>17</td>
<td>27.4</td>
</tr>
<tr>
<td>General Unit</td>
<td>45</td>
<td>72.6</td>
</tr>
<tr>
<td><strong>Clinical Ladder System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2 (Advanced beginner)</td>
<td>13</td>
<td>21.0</td>
</tr>
<tr>
<td>N3 (Competent)</td>
<td>16</td>
<td>25.8</td>
</tr>
<tr>
<td>N4 (Proficient)</td>
<td>33</td>
<td>53.2</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate degree</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>48</td>
<td>77.4</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>13</td>
<td>21.0</td>
</tr>
</tbody>
</table>
Table 4. Unit Data on ICUs and General Units

| Unit Characteristics | Intensive Care Units  
|                      | ($n = 17$) | General Units  
|                      | ($n = 45$) | Total Units  
|                      | ($n = 62$) |
| Mean ($SD$) | Mean ($SD$) | Mean ($SD$) |
| Registered nurses   | 27.8 (14.5) | 18.4 (9.6) | 21.0 (11.8) |
| Nurse assistants    | 1.9 (1.3)   | 0.8 (0.7)  | 1.1 (1.0)   |
| Nurse experts       | 9.1 (6.9)   | 4.9 (6.0)  | 6.1 (6.5)   |
| Patient beds        | 13.8 (6.3)  | 42.0 (19.3) | 34.3 (21.0) |
Table 5 shows the frequency of medication errors in the intensive care and general units. Thirty-eight nursing units (61.3%) reported no medication errors during the study period, and 29 (46.8%) of these were general units. The other 24 units reported at least one medication error, and one ICU had 5 medication errors.

Table 6 shows the types of medication errors in the study. In all the intensive care and general units, the total number of medication errors was 47. In both ICUs and general units, the highest percentages of medication errors (45.8% and 52.2%) were attributed to the wrong dose. There was no medication errors in which the wrong patient was given a medication.

**Phase I: Instrument Assessment**

Since the Technology Instrument was revised and translated into Chinese for use by head nurses, assessment of the adequacy of the translated - back translated version was necessary. The psychometric properties of the Chinese version of the Unit Technology Instrument also needed to be determined.

**Consistency of the Translated - Back Translated Versions**

As noted earlier, five native English speakers who were doctoral students at the School of Nursing, University of North Carolina at Chapel Hill, were invited to examine the two versions of the Technology Instrument. Item-to-item agreement between the two English versions was analyzed using Kendall’s W test. The coefficient of concordance was .41 with a $p$ value of 0.01 ($p < .05$), which implied the agreement in these ranking scores.

**Content Validity Assessment**

A panel of experts composed of five head nurses at a medical center and a local hospital in southern Taiwan examined content validity. All participants were female and they ranged in age from 37- 47 years ($mean = 45.4$ years; $SD = 2.07$); their average
Table 5. Frequency and Number of Medication Errors in ICUs and General Units

<table>
<thead>
<tr>
<th>Frequency of Errors</th>
<th>Intensive Care Units (n = 17)</th>
<th>General Units (n = 45)</th>
<th>Total Units (n = 62)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>Number of errors</td>
<td>Unit</td>
</tr>
<tr>
<td>0</td>
<td>9</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>24</td>
<td>45</td>
</tr>
<tr>
<td>Types</td>
<td>Intensive Care Unit (n = 17)</td>
<td>General Unit (n = 45)</td>
<td>Total (n = 62)</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------</td>
<td>-----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
</tr>
<tr>
<td>Wrong Medication</td>
<td>7 (29.1)</td>
<td>5 (21.7)</td>
<td>12 (25.5)</td>
</tr>
<tr>
<td>Wrong Patient</td>
<td>0 (00.0)</td>
<td>0 (00.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Wrong Time</td>
<td>6 (25.0)</td>
<td>5 (21.7)</td>
<td>11 (23.4)</td>
</tr>
<tr>
<td>Wrong Dose</td>
<td>11 (45.8)</td>
<td>12 (52.2)</td>
<td>23 (48.9)</td>
</tr>
<tr>
<td>Wrong Route</td>
<td>0 (00.0)</td>
<td>1 (4.3)</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td>Total</td>
<td>24 (100)</td>
<td>23 (100)</td>
<td>47 (100)</td>
</tr>
</tbody>
</table>
working experience in the hospital was 18.2 years ($SD = 4.44$). Demographic
c characteristics of the experts are shown in Table 7.

The aforementioned content validity procedure (using a 4-point ordinal rating scale
and dropping items with a CVI < .80) was used for assessment of the content validity of
the Unit Technology Instrument. The total number of items was 16. The CVI for the
items on the instrument ranged from .60 to 1.0. Four of the 16 items had CVI values less
than the .80 cut off. The experts said that these 4 items were not suitable for use both in
general units and ICUs. For instance, one question was, “How many of the patients on
your unit receive continual sedation?” Patients who receive continual sedation would not
be put on a general unit. Another question was “How many of the patients on your unit or
their family have an unanticipated requirement for nurses, which causes nurses to alter
their activities or treatment?” An unanticipated requirement for nurses from the patient’s
family is rare in ICUs. Therefore, these four items were deleted. The total CVI for the
remaining items was .92.

Reliability of the Instruments

The reliability of all instruments was computed using Cronbach’s coefficient alpha.
The following reliabilities were obtained: Unit Technology Instrument ($\alpha = 0.83$),
Professional Autonomy Scale ($\alpha = 0.75$), Attitudes toward Participation ($\alpha = 0.90$),
Atmosphere for Participation ($\alpha = 0.83$), Centralization of Authority Instrument ($\alpha =
0.71$), and Formalization of Authority Instrument ($\alpha = 0.76$). All were considered reliable
for use in the study.

Preliminary Assessment of Validity of the Unit Technology Instrument and the
Attitude on Participation Scale

Since the Technology Instrument was revised and translated into Chinese and no validity
information was available on the Attitude on Participation Scale, a preliminary
### Table 7. Demographic Characteristics of Content Validity Experts (n = 5)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Demographic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Type of Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical center</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Local hospital</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Type of Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Ward</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Type of License</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>RN and Nurse practitioner</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>Clinical Ladder System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N3 (Competent)</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>N4 (Proficient)</td>
<td>3</td>
<td>60</td>
</tr>
</tbody>
</table>
was conducted in this study to provide some information on the validity of these two instruments. These should be little correlation between the variables on the two instruments if they had discriminant validity. The correlation between the two measures \( r = -.10; p = .46 \) indicated that the concepts on the two instruments are distinct from each other.

**Phase II: Data Aggregation**

To determine whether data from the nurses could be aggregated to the unit level, within-group agreement \( (r_{wg}) \), eta-squared coefficient \( (\eta^2) \), and the \( F \) ratio were used. As mentioned earlier, \( r_{wg} \geq 0.70 \), \( \eta^2 \) coefficient > .20, and a significant \( F \) ratio were suggested to judge the adequacy of aggregation. The results of the test of within-group agreement indicated that the \( r_{wg} \) were 0.81, 0.93, and 0.79 for the Professional Autonomy Instrument, Attitude on Participation Scale, and Authority Instrument, respectively, and the \( r_{wg} \) of the subscales in the three instruments ranged from .75 to .93, indicating consistency across items.

Eta-squared coefficient and the \( F \) ratio were used to assess whether the individual level data could be aggregated to the unit level based on whether the within-group variance in responses was less than the between-group variance in responses. The range of \( \eta^2 \) coefficients was from .12 to .41, and the \( F \) ratio was significant \( (p < .05) \) for all instruments and subscales. Although \( \eta^2 \) for the Professional Autonomy Instrument \( (\eta^2 = .12) \) and for the centralization subscale of the Authority Instrument \( (\eta^2 = .17) \) was less than the .20 that researchers recommend (James, Demaree, & Wolf, 1993; Lindell, Brandt, & Whitney, 1999), the \( F \) ratio indicated a significant difference between within-group and between-group variances. These findings indicated that aggregation of individual data to the unit level was warranted.
Phase III: Hypothesis Testing

In exploring the relationships between the variables in the study framework, an analysis issue arose. According to the literature, to test for significance of PPM correlation coefficients, a bivariate normal distribution of study variables is essential (Chen & Wang, 2009). Since 38 units (61.3%) reported no medication errors and one nursing unit reported 5 medication errors (Table 5), there was a non-normal distribution of medication errors.

Two solutions were attempted. First, normal distribution was tested for the two groups, and when the non-normal distribution was identified, log transformations were used on medication error rates. Second, analyses for units with medication errors \( (n = 24) \) and analyses for all units \( (n = 62) \) were computed separately. Measures of normal distribution were skewness and kurtosis, using the rule of thumb of between -2 and +2 (Toriningen, 2011). Since a requirement for log transformation is that the number must be greater than 0 (Kline, 2011), for a group with 62 units, for each unit 1 was added to the frequency of medication errors (i.e., 1 medication error in a unit with no errors and 4 medication errors in a unit with 3 errors). Following this, the medication error rates were recalculated (Kline, 2011).

Table 8 shows that the total group had positive skewness and kurtosis before log transformation. The log transformation data were subsequently used in the total group analysis.

Results of Hypothesis Testing

This section summarizes the tests of the hypotheses presented in Chapter 2. Each hypothesis is repeated and the relevant results presented, for both the units with medication errors and the total units. Tables 9 through 11 provide the results. Table 12 lists the hypotheses and the findings.
Table 8. Normal Distribution Test for 2 Groups of Units

<table>
<thead>
<tr>
<th></th>
<th>Units with Medication Errors (n = 24)</th>
<th>Total Units (n = 62)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before implementing log transformation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skewess</td>
<td>1.66</td>
<td>2.92</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2.15</td>
<td>8.87</td>
</tr>
<tr>
<td><strong>After implementing log transformation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skewess</td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td>Kurtosis</td>
<td></td>
<td>-.50</td>
</tr>
</tbody>
</table>
Results for the hypotheses were as follows:

**Hypothesis 1a (H1a):** Technology is positively associated with the rate of medication errors in a nursing unit.

Pearson correlation was used to examine the relationship between unit technology and medication error rate. For the subset of units with medication errors, it was found that $r = .74, p < .01$. For the total units, the result was $r = .57, p < .05$. Hypothesis 1a was thus supported.

**Hypothesis 1b (H1b):** Technology is positively associated with the degree of professional autonomy in a nursing unit.

A significant relationship was found between unit technology and professional autonomy in the units with medication errors ($r = -.41; p < .05$); however, for the total units, the result was $r = .05; p > .05$, indicating non significance.

**Hypothesis 1c (H1c):** Technology is positively associated with the degree of participation in decision making in a nursing unit.

There was no significant association between unit technology and participation in decision making in either the units with medication errors ($r = -.35; p > .05$) or the total units ($r = -.10; p > .05$).

**Hypothesis 1d (H1d):** Technology is negatively associated with the degree of formalization in a nursing unit.

There was no significant relationship between unit technology and formalization in either the units with medication errors ($r = -.28; p > .05$) or in the total units ($r = -.21; p > .05$).
Hypothesis 2a (H2a): A higher proportion of RNs in the skill mix is associated with a lower rate of medication errors.

A negative relationship was found between RN skill mix and the medication error rate in the total units \((r = -.26, p < .05)\). However, no significant relationship was found for the units with medication errors \((r = -.35; p > .05)\).

Hypothesis 2b (H2b): A high proportion of RNs in skill mix positively related to professional autonomy.

RN skill mix was not significantly correlated with professional autonomy in either the units with medication errors \((r = .33; p > .05)\) or the total units \((r = .08; p > .05)\).

Hypothesis 3a (H3a): The proportion of expert nurses is inversely related to medication errors.

Though medication error rates were expected to be lower in nursing units with a high proportion of nursing experts, no significant relationship was found in either the total units \((r = .25; p > .05)\) or the units with medication errors \((r = .18; p > .05)\).

Hypothesis 3b (H3b): The proportion of expert nurses is positively related to professional autonomy in a nursing unit.

A significant association was found \((r = .30; p < .05)\) in the total units, but not in the units with medication errors \((r = .27; p > .05)\).

Hypothesis 3c (H3c): The proportion of expert nurses is positively related to the degree of participation in decision making in a nursing unit.
In the total units, one of the subscales of the Attitude on Participation Scale was positively related to the proportion of expert nurses \((r = .28; p < .05)\), but the other was not \((r = .06; p > .05)\). There was no significant association between the proportion of expert nurses and participation in decision making in units with medication errors \((r = .11; p > .05)\).

**Hypothesis 3d (H3d):** The proportion of expert nurses is negatively related to the degree of formalization in a nursing unit.

In the total units, a significant relationship was found between the proportion of expert nurses and formalization \((r = .30; p < .05)\), but the direction of the relationship was not anticipated. In the units with medication errors, the proportion of expert nurses was not significantly associated with formalization \((r = .31; p > .05)\).

**Hypothesis 4a (H4a):** Unit size is positively associated with the rate of medication errors.

Although unit size was significantly related to medication error rates in both units with medication errors \((r = -.68; p < .01)\) and total units \((r = -.70; p < .01)\), the relationship between unit size and medication error rate was negative, which was unexpected. Since ICUs usually have fewer patient beds than general units, a further analysis was conducted to determine whether the relationship between unit size and medication error rate differed because of type of unit. When only general units were included in the analyses, there was a significant negative relationship between unit size and medication error rate both in the units with medication errors \((r = -.85; p < .01)\) and the total units \((r = -.56; p < .01)\). However, when only ICUs were analyzed, no significant relationship was found between unit size and medication error rate.
Hypothesis 4b (H4b): Unit size is positively related to degree of professional autonomy.

A significant relationship was found but again, unexpectedly the relationship was negative in both the units with medication errors ($r = -.42; p < .05$) and the total units ($r = -.29; p < .01$).

Hypothesis 4c (H4c): Unit size is positively related to degree of participation in decision making.

No significant relationship was found between unit size and participation in decision making in either units with medication errors ($r = -.40; p > .05$) or total units ($r = .07; p > .05$).

Hypothesis 4d (H4d): Unit size is inversely related to degree of formalization.

No significant association between formalization and medication error rate was found in either group of units.

Hypothesis 5a (H5a): The rate of medication errors is significantly higher in ICUs than in non-ICUs.

The medication error rate was significantly higher in ICUs than in general units in both units with medication errors ($t = -6.76; p < .05$) and total units ($t = -8.73; p < .05$).

Hypothesis 5b (H5b): The degree of professional autonomy is significantly higher in ICUs than in non-ICUs.

A significant relationship was not found in either group of units.
Hypothesis 6 (H6): Nurse professional autonomy is inversely related to medication errors.

Professional autonomy was positively correlated with medication error rates both in the units with medication errors ($r = .43; p < .05$) and the total units ($r = .33; p < .01$). The direction of this relationship was not anticipated.

Hypothesis 7 (H7): Participation in decision making is negatively associated with the rate of medication errors in a nursing unit.

No significant relationship was found between participation in decision making and medication error rates in the units with medication errors ($r = - .33; p > .05$) or the total units ($r = .02; p > .05$).

Hypothesis 8 (H8): Formalization is negatively related to medication errors in a nursing unit.

No significant relationship was found between formalization and medication error rates in the units with medication errors ($r = -.35; p > .05$) or the total units ($r = -.11; p > .05$).
Table 9. Correlations among Study Variables in Units with Medication Errors ($n = 24$)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Professional Autonomy</th>
<th>Attitude on Participation</th>
<th>Authority</th>
<th>Medication Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Atmosphere</td>
<td>Attitude</td>
<td>Centralization</td>
</tr>
<tr>
<td>Technology</td>
<td>-.41*</td>
<td>-.35</td>
<td>-.30</td>
<td>-.10</td>
</tr>
<tr>
<td>RN Skill Mix</td>
<td>.33</td>
<td>-.30</td>
<td>-.31</td>
<td>-.19</td>
</tr>
<tr>
<td>Nurse Experts</td>
<td>.27</td>
<td>.11</td>
<td>.15</td>
<td>.46*</td>
</tr>
<tr>
<td>Unit Size</td>
<td>-.42*</td>
<td>-.40</td>
<td>-.33</td>
<td>.35</td>
</tr>
<tr>
<td>Medication Errors</td>
<td>.43*</td>
<td>-.33</td>
<td>-.31</td>
<td>-.18</td>
</tr>
</tbody>
</table>

Note: * $p < 0.05$, ** $p < 0.01$
Table 10. Correlations among Study Variables in Total Units ($n = 62$)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Professional Autonomy</th>
<th>Attitude on Participation</th>
<th>Authority</th>
<th>Medication Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Atmosphere</td>
<td>Attitude</td>
<td>Centralization</td>
</tr>
<tr>
<td>Technology</td>
<td>.05</td>
<td>-.10</td>
<td>-.09</td>
<td>-.05</td>
</tr>
<tr>
<td>RN Skill Mix</td>
<td>.08</td>
<td>.05</td>
<td>.03</td>
<td>-.04</td>
</tr>
<tr>
<td>Nurse Experts</td>
<td>.30*</td>
<td>.06</td>
<td>.28*</td>
<td>.36**</td>
</tr>
<tr>
<td>Unit Size</td>
<td>-.29*</td>
<td>.07</td>
<td>-.00</td>
<td>.09</td>
</tr>
<tr>
<td>Medication Errors</td>
<td>.33**</td>
<td>.02</td>
<td>.12</td>
<td>.14</td>
</tr>
</tbody>
</table>

Note: * $p < 0.05$, ** $p < 0.01$
Table 11. \( t \) test for Differences in the 2 Groups of Units

<table>
<thead>
<tr>
<th>Variables</th>
<th>Units with Medication Errors ( (n = 24) )</th>
<th>All Units ( (n = 62) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Autonomy</td>
<td>-.62</td>
<td>-1.13</td>
</tr>
<tr>
<td>Participation in Decision Making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmosphere</td>
<td>1.77</td>
<td>1.57</td>
</tr>
<tr>
<td>Attitude</td>
<td>1.90</td>
<td>0.64</td>
</tr>
<tr>
<td>Formalization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralization</td>
<td>0.89</td>
<td>0.06</td>
</tr>
<tr>
<td>Formalization</td>
<td>2.76*</td>
<td>3.29*</td>
</tr>
<tr>
<td>Medication Error Rates</td>
<td>-6.76**</td>
<td>-8.73**</td>
</tr>
</tbody>
</table>

Note: * \( p < 0.05 \), ** \( p < 0.01 \)
Table 12. List of Hypotheses (Predicted Direction of Relationships) and Significance and Direction of Findings

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Findings</th>
<th>Units with Medication Errors</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(n = 24)</td>
<td>(n = 62)</td>
</tr>
</tbody>
</table>

**Relationships of Organizational Context with Medication Errors**

- **H1a**: Technology with Medication Errors (+)  
  Finding was significant in predicted direction
- **H2a**: Skill Mix with Medication Errors (-)  
  Finding was non-significant
- **H3a**: Nurse Experts with Medication Errors (-)  
  Finding was non-significant
- **H4a**: Unit Size with Medication Errors (+)  
  Finding was non-significant
- **H5a**: Unit Type with Medication Errors (+)  
  Finding was significant in predicted direction

**Relationships of Organizational Context with Practice Structure**

- **H1b**: Technology with Autonomy (+)  
  Finding was non-significant
- **H1c**: Technology with Participation (+)  
  Finding was non-significant
- **H1d**: Technology with Formalization (-)  
  Finding was non-significant
- **H2b**: Skill Mix with Autonomy (+)  
  Finding was non-significant
- **H3b**: Nurse Experts with Autonomy (+)  
  Finding was significant in predicted direction
- **H3c**: Nurse Experts with Participation (+)  
  Finding was significant in predicted direction
- **H3d**: Nurse Experts with Formalization (-)  
  Finding was non-significant

Note: NS = Non Significant  
  v = Finding was significant in predicted direction  
  -- = Finding was significant but in opposite direction of hypothesis
Table 12: List of Hypotheses (Predicted Direction of Relationships) and Significance and Direction of Findings (Continued)

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Findings</th>
<th>Units with Medication Errors</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4b: Unit Size with Autonomy (+)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>H4c: Unit Size with Participation (+)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>H4d: Unit Size with Formalization (-)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>H5b: Unit Type with Autonomy (+)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Relationships of Practice Structure with Medication Errors

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Findings</th>
<th>Units with Medication Errors</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>H6: Autonomy with Medication Errors (-)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>H7: Participation with Medication Errors (-)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>H8: Formalization with Medication Errors (+)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: NS = Non Significant

υ = Finding was significant in predicted direction
-- = Finding was significant but in opposite direction of hypothesis
Summary

Six-two head nurses and 977 staff nurses from 17 intensive care units and 45 general units participated in the study. Unit data showed that 38 of the nursing units had no medication errors. The semantic and content equivalence of the two versions of the technology instrument was adequate, with significant coefficients. Five nurse experts assessed content validity, and 12 items with an acceptable content validity index were retained. Reliabilities for all instruments used in the study ranged from .71 to .83. Discriminnt validity of the Unit Technology Instrument was tested by association with the Attitude on Participation Scale, and a non-significant finding was shown. The Eta-squared coefficient ($\eta^2$), inter-item consistency ($r_{wg}$), and $F$ ratio showed that data at the individual level could be appropriately aggregated to the unit level. Finally, in hypothesis testing, four variables -- technology, skill mix, unit size, and unit type -- were found to be associated with medication error rates. Only the proportion of nurse experts and unit size were related to professional autonomy, which was the only practice structure variable that was related to medication error rates.
CHAPTER V
DISCUSSION

In this chapter the findings presented in the Chapter IV are discussed. Although the findings between the two sets of units were similar, there were more findings for total units than for units with medication errors. Thus, the discussion focuses on the total units. Implications for nursing are identified and methodological limitations are presented. Recommendations for further research are noted.

Hypothesis Testing

The following section discusses the findings for the hypotheses.

Technology

Technology was positively related to medication errors, indicating that nursing units with highly complex technology had higher medication error rates. Hypothesis 1a was supported; however, this finding is not inconsistent with other studies, which have found no significant impact of technology on patient safety outcomes, including medication errors and patient falls (Mark et al., 2003).

Technology refers to the complexity of nursing care requirements due to rapidly changing patient conditions, varied diagnoses of patients, and lack of knowledge about patients’ conditions or applicable techniques. It is not clear why technology was related to medication errors in the current study. However, as noted earlier (Chapter 2), technology may be viewed as a proxy for patient acuity, so it makes sense that technology influences nursing hour utilization and it can be considered a source of stress and heavy workload, which may lead to slips or violations (Cox, 2003; Dugan et al., 1996). Many empirical
studies have shown that time limitations, heavy workloads, high patient acuity, lack of access to patient information, and inability to control patient conditions are causes of medication errors or near errors (Balas, Scott, & Rogers, 2006; Carlton & Blegen, 2006; Wolf, Hicks, & Serembus, 2006). Thus, it is not surprising that a high degree of technology increased the rate of medication errors in nursing units.

The major difference between the current study and previous studies is that the participants who filled out the technology instrument in this study were head nurses rather than staff nurses, as in prior studies. Although this might explain the differences, one would then expect other difference in the findings on technology. However, the rest of the findings on technology in this study were consistent with those of previous research. For instance, as in this study, Mark et al. (2003) and Cox (2003) found no relationships between technology and professional practice structure or conflict management.

No relationships between technology and practice structure, including professional autonomy, participation in decision making, and formalization, were found in the current study; thus Hypotheses 1b, 1c, and 1d were not supported. These findings are also inconsistent with previous studies. However, comparisons between this study and previous studies are not possible because previous studies used sub-dimensions of technology, such as uncertainty or variability, to examine associations, while in this study technology as a whole was the variable. Since the number of units in this study was small \((n = 62)\), it was also not possible to examine factors in the dimensions of technology using exploratory factor analysis. Thus, at this point, the relationships between technological factors and aspects of the practice structure, such as professional autonomy, are unknown. More subjects would be needed to understand the impact of technology on practice structure.
Skill Mix

Skill mix, defined as the proportion of registered nurses in a nursing unit, was negatively associated with the rate of medication errors in the current study. This finding is consistent with previous research, which found that RN skill mix in a patient care unit was associated with the rate of medication errors (Blegen et al., 2001; Whitment et al., 2002). However, while the findings of this study are consistent with those of other studies, it is important to note one discrepancy between the current study and others. The proportion of RNs in this study ranged from 82% to 100%, unlike many studies in the U.S. Since a high proportion of nursing aides in nursing units is not common in Taiwanese hospitals, the nursing units used in these analyses had a high proportion of RNs in the skill mix. The findings have differed from one Taiwanese study (Lee et al., 2005) that examined the effects of different skill mixes on nursing personnel costs and the quality of care in a 54-bed gastro-intestinal (GI) unit. Lee and colleagues found that the medication error rate did not differ between the pre-test (100% of RN skill mix, for 25 RNs) and post-test (76% of RN skill mix, 22 RNs and 7 nursing aides). Lee et al.’s study, however, had a small sample and the specific unit type prevents comparisons. The findings of the current study are generally consistent with the findings from other studies that a negative relationship exists between skill mix and medication errors.

Nurse Experts

The findings on nurse experts also suggest that units with a high proportion of expert nurses (N3 and N4) are more likely to have lower medication error rates, though the hypothesis on this (3a) was not supported. While no significant association was found, the positive direction of the relationship was consistent with the hypothesis. Other studies conducted by Taiwanese researchers have found that the proportion of N3 and N4 nurses in a nursing unit affected medication error rates, although the data in these studies were
collected from individuals and the analysis was conducted at the individual level. In this study, no direct association was found between the proportion of nurse experts and medication error rates; however, as noted above, the proportion of nurse experts was significantly related to professional autonomy, which was in turn significantly related to medication error rates. It is therefore logical to expect an association between the proportion of nurse experts and medication error rates.

The proportion of nurse experts was associated with professional autonomy and participation in decision making, and the direction of the relationships was consistent with the literature. The positive association with autonomous practice indicates that nurses perceived a higher degree of autonomy in their professional practice and felt more able to give their opinions regarding administration or unit development when their unit had more members at N3 or N4. This finding is consistent with other studies (Manias et al., 2005; Tranmer, 2005; Scott, 2009).

In general, in business and management discipline, employees who perceive a high degree of decentralization often report a low degree of formalization (Daft, 2009). However, in this study, units with a high proportion of nurse experts reported a high degree of both decentralization and formalization, suggesting that nurses in these units experienced a high degree of professional autonomy and participation in decision making but also perceived rule or regulation restrictions in their units. Although this finding did not support the hypothesis, it suggests that nurse experts are more sensitive to rule and regulation restrictions and report a higher degree of formalization than non-experts.

Unit Size

Hypothesis 4a proposed that unit size would be positively associated with medication error rates. A relationship was found, but the direction was contrary to that expected. That is, nursing units with more patient beds had lower medication error rates.
This is inconsistent with other studies, which found higher rates of medication errors in units with more patient beds (Vogus et al., 2007).

One possible explanation for the difference is that a significant inverse association between unit size and technology ($r = -.44, p < .001$) was found in this study. Head nurses who worked in large units reported a low degree of technology in their units. As noted earlier, a positive relationship was found between technology and medication errors in the study. Also, intensive care units had fewer patient beds than general units in this study ($t = 8.98, p < .000$). General units have a less complex environment than intensive care units, and the drugs that patients receive in these units are less varied than in intensive care units. Thus, units with more patient beds tend to have a lower degree of technology. The relationships between unit size, technology and unit type help to explain the lower medication error rates in large units than in small unit in this study.

Like Hypothesis 4a, Hypothesis 4b, which examined the relationship between unit size and professional autonomy, was not supported because of the unexpected direction of the relationship. As with Hypothesis 4a, the relationship between unit size and technology may help explain the inverse relationship between unit size and professional autonomy. Scholars have found that nurses require more authority when the instability of patient conditions and the variability of patient problems increase (Bauerschmidt et al., 1987; Loveridge, 1988). In this study, large units tended to have a low degree of complexity and uncertainty about patients’ needs because of their diseases and conditions. Perhaps this made nurses in large units require less authority to make patient-related decisions.

No significant associations were found for Hypotheses 4c and 4d, indicating that the number of unit beds was not associated with degree of participation in decision making or formalization in a nursing unit. This is not consistent with previous studies (Daft, 2009). The instrument used in this study may help to explain this. The two subscales of the
Attitude on Participation Scale address the atmosphere of participation created by head nurses and staff nurses’ attitude and willingness to be involved in decision making. For instance, Item 12 is “Nurses should be allowed to participate in decision making in the work place on matters that affect them,” and Item 6 is “Nurses feel comfortable about offering their opinion to supervisors at work.” The items in the Attitude of Participation Scale, however, do not examine actual behaviors and activities of participation. Thus, it is possible that unit size has no relationship to nurses’ perception of participation in decision making if nurses’ attitudes toward participation are consistently high or low throughout the nursing units.

Connor’s (1992) study provided another explanation for this finding. Connor examined the effect of organizational context on participation in decision-making in 101 nursing homes and found that size was significantly correlated with the topics of decision making. For instance, significant differences were found between large and small nursing homes in regard to making financial, purchasing, maintenance, or patient care decisions. Employees tended to participate in making decisions about policy or operations rather than individual benefits or skill implementation (Kreiner, Kinicki, & Buelens, 2002). This provides a hint that unit size may be correlated with participation in decision making; however, investigation of this should focus on specific participation patterns.

Unit size was not associated with formalization, so Hypothesis 4d was not supported. Auh and Menguc (2007) also found that unit size had no impact on formalization; however, in this study, data were collected from the management team (e.g., chief executive officer). In the current study, the operational definition of formalization focused on nurses following written work rules, procedures, or a handbook in their job. Further, this study collected data only from inpatient units in three reasonably
homogeneous hospitals. Therefore, although unit size differed, the nurses’ practice tasks were fairly similar, limiting the variance in formalization.

**Type of Unit**

Hypothesis 5a that intensive care units (ICUs) would have a higher rate of medication errors than general units was supported. Numerous other studies have also supported this. As many researchers have explained, the intensive care unit environment is complex and patient acuity is high, the medications are varied, the frequency of administering medications is high and distractions and interruptions are common (Carlton & Blegen, 2006; Ulanimo et al., 2007; Valentin et al., 2009). It is thought that patients in ICUs receive twice the drugs of patients in non-ICUs. Additionally, patients in ICUs are administered more concentrated drugs (Hughes & Blegen, 2006). Thus, type of unit has some input into medication error rates.

**Autonomy**

This study found a positive relationship between professional autonomy and the rate of medication errors (Hypothesis H6), suggesting that the error rate was higher on units with nurses who had a high degree of professional autonomy. This has been seen in few other studies, and it is not clear why professional autonomy positively influences medication errors. One possible explanation is provided below.

Professional autonomy is believed to affect nurses’ time distribution in their role functions. Irvine et al. (1998) noted that classifications of nurses’ roles include a dependent role (e.g., treatment or execution of medical orders), an independent role (e.g., assessment, intervention, evaluation), and an interdependent role (e.g., communication, coordination of care, monitoring and reporting). Each role leads to different outcomes. Doran and her colleagues (2002), who examined the impact of role performance on selected patient outcomes for medical-surgical patients, found that autonomy was
associated with nurses’ interdependent role function. The participants in Doran et al.’s study reported that nurses with high autonomy had less time to provide patient care in their dependent role function, which consequently influenced patient safety outcomes.

In the current study, the measure of professional autonomy was composed of items which also emphasized nurses’ interdependent role, e.g., communication or reporting, rather than their dependent role. For instance, “Nurses in my unit have fulfilled their responsibility when they report patients’ conditions to a physician,” or “When a patient disagrees or doubts a physician’s intervention, nurses are willing to advocate on the patient’s behalf.” Based on Doran et al.’s (2002) study, a possible conclusion here is that nurses with high degrees of professional autonomy spend much of their time in the interdependent role rather than the dependent role and their performance of the dependent role (e.g., medication administration) might be negatively influenced by this. Therefore, a high degree of professional autonomy may result in a high rate of medication errors in a nursing unit.

**Participation in Decision Making**

Hypothesis 7, that nursing units with a high degree of participation in decision making (PDM) would have lower medication error rates than those with a low degree of PDM, was not supported. Professional autonomy and participation in decision making were derived from an identical concept – centralization. As noted earlier, however, professional autonomy referred to nurses’ freedom to make decisions related to clinical practice. In contrast, participation in decision making referred to nurses’ involvement in decision-making process that guides the work of their unit or organization, not their clinical practice. Thus, participation in decision making on patient safety may have had no relationship to actual practice.
Formalization

Hypothesis 8, which proposed that degree of formalization would be negatively associated with medication error rate, was not supported. A possible explanation may be that the instrument used in this study was not sensitive enough. As noted earlier, administering medication is a rigid process and does not allow deviation. Therefore, explicit written documents such as policies, procedures, and protocols are important, and strictly following these documents is required. For example, two nurses are required to administer narcotic medications (e.g., double-checking). However, the instrument used in this study addressed nurses’ practice activities generally, rather than emphasizing specific policies, procedure, or protocols in regard to medication administration. A more focused instrument might have help reveal a relationship if one exists.

Other Findings

While there were some significant associations among the variables in this study, a number of findings were not consistent with the literature. Second, few associations were found between organizational context and practice structure, or between practice structure and medication errors. The proportion of nurse experts was the only variable associated with participation in decision making and formalization, and professional autonomy was the only variable in practice structure that was related to medication error rate.

There are two possible explanations for these findings. The first is that the components of the practice structure selected for study may not be sensitive to organizational context and medication errors. The fact that there were few associations between macro-organizational level variables and medication errors may suggest that the variables selected account for a very limited amount of the variance in medication errors, though this was not tested in the current study. Mark et al. (2003) also found no relationship between professional practice structure and medication errors, though the
professional practice structure did explain 18% of the variance in patient falls. Since structure includes more than centralization and formalization (for example, standardization, specialization, etc.) (Zinn & Mor, 1998), other elements of organizational structure may need to be considered as possible determinants of medication errors.

Further, some studies have shown that the interaction of variables can be significant even when individual variables are not significantly associated (Aaronson, Zinn, & Rosko, 1994; Branco, Teno, & Mor, 1995). For instance, Vogus and Sutcliffe (2007) reported that safety organizing and trust in leadership were not related to reported medication errors. However, the interaction of safety organizing and trust in leadership negatively affected reported medication errors. Moreover, the safety climate, moderated by the complexity of patient conditions, affected medication errors (Hormann & Mark, 2006). This suggests that models specifying the relationships between safety climate and safety outcomes may need to include interactions between variables. Because the current study was an initial examination, it looked only at simple relationships between variables. To explore more complex relationships between variables, it would be essential to include the interactions between variables, including further investigation of congruence and contingency relationships among them.

**Implications for Research**

Viewing medication errors and patient safety as the final result of a failure of the system allows researchers to consider several different theoretical models for examining organizational dynamics. This study has shown that structural contingency theory provides a theoretical foundation for examining the relationships of contextual and structural factors to outcomes. Although the study focused on associations between selected organizational variables, the study not only provides some support for the use of a
macro-level approach to examine system- or organization-level factors but also shows the connections to meso- and micro-level approaches.

As mentioned in Chapter 1, structural contingency theory views structure in terms of strategic dimensions which affect the interactions among employees and in turn reflect team-related (meso-level) dynamics. For example, autonomy as a structural variable influences nurse perceived support and trust, and enhancement of communication, cooperation, and coordination of patient care (Laschinger et al., 2001; Norsen, Opladen, & Quinn, 1995). Many studies that took a meso-level approach have shown the effects of team-related factors on safety outcomes, such as back-up behaviors (Baker et al., 2003), shared mental models (Edmondson, 2003), safety climate (Hofmann & Mark, 2006), and psychological safety (Nembhard & Edmondson, 2006), which affect the micro-level to study individual behaviors and actions such as slips and lapses.

This study has also shown the connections between error management and prevention. For instance, the rate of medication errors was collected from nurse reporting, which is a component of error detection. As noted in Chapter 1, the degree of centralization of the organizational structure reflects the distribution of authority and the extent to which decisions are made by top level managers. Under this supervision, nurses are allowed less to participate in decision making. In this sense, nurses are unfamiliar with making decisions independently; thus, when error occurs, nurses are less confident in reporting the error independently without shift leaders’ or nurse managers’ permission.

Health services researchers can use a macro-level approach to better understand how particular medication errors occur in the organization or work situations. This approach links the seemingly disparate approaches to error prevention together, allows different causes of medication errors to be studied simultaneously, and allows the results to be
generalized more easily to micro- and meso-level prevention. On the other hand, the study that used micro- and meso- level approach also provides information across organization.

**Implications for Nursing**

As healthcare organizations emphasize and strengthen clinical practices, for example by using Bar-coded medication administration to minimize medication errors, nursing administrators should also focus on strengthening organizational and structural characteristics that have been shown to minimize medication errors. Strategies to manage the characteristics of nursing units shown to affect the rate of medication errors should be implemented. For instance, maximizing the proportion of registered nurses in nursing units is a strategy that has been shown to reduce medication errors.

Professional practice structures characterized by high nurse autonomy, control over nurse practice, participation, and nurse-physician collaboration have been shown to produce better outcomes such as lower mortality rates and higher nurse satisfaction, but they have had limited effects on patient safety outcomes, such as medication errors (Aiken, 2002; Mark et al., 2003, 2008). However, this study showed a significant positive relationship between autonomy and medication errors. The findings from the study thus provide some direction for head nurses in developing a nursing practice structure. Although more information is needed, the study gives head nurses a hint to consider strategies that require shifts in the control mechanisms in units, such as the degree of autonomy or restrictions on practice.

In addition, there is information to suggest that complexity or uncertainty of patient conditions may lead to a high rate of medication errors. Nursing continuing education programs can be designed to include situation-based techniques to learn control skills in complex or uncertain situations. The goal of these programs would be individual mastery
of the skills necessary to exert control over potentially threatening interactions between nurses and patients, to ensure low variation in practice.

**Limitations**

The findings of this study must be considered in light of its methodological limitations. First, sample-related issues limit generalizability. This study was conducted using a convenience sample of three acute care hospitals that are members of the Taiwan Nurses Association, and all implemented a four-level clinical ladder system. Although the sample may be representative of hospitals nationwide, it is not known how hospitals that do not participate in the Taiwan Nurses Association differ from those that do. Additionally, hospitals in Taiwan are classified into three levels: medical center, local hospital, and regional hospital. In this study, only nursing units in local hospitals and a medical center were studied.

Sixty percent of the study units reported no error occurrences during the study period (3 weeks). This may reflect underreporting, the sensitivity of the research question, or the short study period. Data on medication administration errors in nursing units were obtained through self report. Although Evans and associates’ (2006) study has shown self reports to be adequate for routine errors with immediate outcomes (e.g., medication errors), some earlier studies noted that self report of errors can vary by type of unit and management activities and may capture only 5-15% of medication errors (Classen, Pestonek, Evans, & Burke, 1991; Edmondson, 2004; Jha et al., 1998). Although the current study examined the data separately for units with medication errors and total units, the results should be viewed with caution (Tomas & Peterson, 2003). Subsequent work should consider using other methods of data collection (e.g., direct observation) to validate data in this sensitive area of research.
Research that focuses on a patient safety problem like medication errors is also likely to be confounded by the concerns of head nurses, who might perceive errors as deriving from management. A potential solution is collection of medication errors at other points in the process, such as transcribing, dispensing, or delivering errors. Finally, it is necessary to extend the study period and obtain data close to actual practice in order to validate the research data.

Lack of translation information on the instruments used in the current study was also a limitation. Since no instrument developed by Taiwanese researchers could be found to examine the variables used in the current study, all the instruments were translated. Although this is a conventional method for many studies, there are some measurement concerns.

Linguistic congruence is one concern about translated instruments. For instance, “shortness of breath” means a quick breathing pattern, rather than “dyspnea”, which means distressed breathing (Yu, Lee, & Woo, 2003). Differences between the U.S and Taiwan in nursing culture are also a concern in using a translated instrument. For instance, there is no nursing manager position in the Taiwanese nursing system. Since the nursing system is more hierarchical than in the U.S., staff nurses view nurse experts as “nurses who are in the top level position” or “nurses who have specific certificates” rather than “nurses who have intuition based on advanced clinical knowledge and experience.”

Although Brislin’s translation – back translation model (190, 1986) is the most popular method of achieving linguistic and cultural equivalence (Hambleton, 1993; Phillips, de Hernandez, & de Ardon, 1994), a lack of information on the translation process in the literature may reduce the validity of the instruments used in the current study.
A final limitation is the service period of head nurses in the units. Typically, nurses’ accommodation to a new head nurse’s management is needed for a month or more. This study, however, had no criteria for head nurses’ service time in their units, and this may have been inadequate to collect relevant information regarding control mechanisms in the practice structure.

**Future Research**

Although this study included important organizational concepts that are thought to be salient to medication errors at the macro level, medication error is a very complex issue. External environmental characteristics, hospital characteristics, patient characteristics, work engagement, work conditions (e.g., conflict management), standardization, and professionalization are other elements of organizational context and structure that have been used by scholars to explain patient safety issues (Chang, 2007; Mark et al., 2003; Cox, 2003). A more complete and complex model could enhance associations and avoid inconsistent relationships among variables (Zinn & Mar, 1988). Moreover, as noted earlier, the concepts of structural contingency theory refer to team-related dynamics or the effects of interactions among employees on performance. Thus, team-related factors, e.g., back-up behaviors and psychological safety, should be added to the study model, and the effects of combining a macro- and meso- level approach to medication safety should be studied.

The analysis here was based on unit level, but 62 nursing units were a small number of units to perform exploratory factor analysis and assess the factor structure of the Unit Technology Instrument. The Chinese version of the Unit Technology Instrument was revised from the English version, and 4 items were discarded because of a low CVI (CVI < .80). This might have altered the original factor structure, which could have influenced the findings. A larger sample is needed in further research.
Scholars have moved to investigate the relationships among all the study variables, both in congruence and contingency relationships, including the effects of combining variables and intervening effects in the relationships between organizational context and performance. This initial study focused on the relationships between variables that should be considered. Although the study purpose was mostly achieved, much remains to be explored. For instance, professional autonomy was associated with medication errors, and the proportion of nurse experts was associated with professional autonomy, but not with medication error rates. Whether professional autonomy is a mediator between the proportion of nurse experts and medication error rates is unknown. Examination of congruence and contingency relationships is suggested for further research.

Several studies have found that technology had direct or indirect effects on organizational outcomes such as work satisfaction or nurse turnover, but not patient safety outcomes, for example, Mark et al (2003) and Cox (2003). The current study is the first to find an association between technology and medication errors. However, the direct and indirect effects of technology on medication errors were not tested. A more complete or full model test is recommended for the future.
Dear Nursing Colleague:

This is to announce a research study that will be done on your unit. This study will
be looking at the effects of the environment and medication errors. A survey will be sent
to you in about 2 days in your hospital mailbox. Completing it will take about 20 minutes
of your time. Your participation in this study is completely voluntary. You will be able to
send the survey back to me in an envelope with postage attached.

Approval has been obtained from the Institutional Review Board of your hospital. If
you have any questions, please contact me at 07-3521881 or by email at
dv749@hotmail.com.

Sincerely,

Chang-Chiao Hung, MSN
Doctoral Student
University of North Carolina at Chapel Hill
School of Nursing
TEL: (07)352-1881
Email: dv749@hotmail.com

Mary R. Lynn, PhD
Professor and Adviser
University of North Carolina at Chapel Hill
School of Nursing
Second Flyer

Dear Nursing Colleague:

A few days ago, you received a survey from me. If you have completed it and returned it, I deeply appreciate your help. If not, please take a few minutes to complete it and return it to me in the postage paid envelope. Your participation is important.

If you have any questions, please contact me at 07-3521881 or by email at dv749@hotmail.com.

Sincerely,

Chang-Chiao Hung, MSN  
Doctoral Student  
University of North Carolina at Chapel Hill  
School of Nursing  
TEL: (07)352-1881  
Email: dv749@hotmail.com

Mary R. Lynn, PhD  
Professor and Adviser  
University of North Carolina at Chapel Hill  
School of Nursing
Final Flyer

Dear Nursing Colleague:

This research study on exploring the effect of unit environment and structure on medication errors will soon be ending. It is not too late to complete and return the questionnaire. If you have not completed it, please take few minutes to do so and return it to me in the postage paid envelope. Your participation is very important.

If you have any questions, please contact me at 07-3521881 or by email at dv749@hotmail.com.

Thank you very much for considering participation.

Sincerely,

Chang-Chiao Hung, MSN
Doctoral Student
University of North Carolina at Chapel Hill
School of Nursing
TEL: (07)352-1881
Email: dv749@hotmail.com

Mary R. Lynn, PhD
Professor and Adviser
University of North Carolina at Chapel Hill
School of Nursing
APPENDIX 2: CONSENT FORM

Consent Form for Nurses (All Hospitals)

Dear Nursing Colleague:

About two days ago, you have received the information about this research survey. I need your help with this research study. We are conducting a research study focused on how the environment in which a nurse works relates to medication errors. We anticipate the results of this study can provide broader picture of improving patient safety so your participation is very helpful and important. You were selected as a possible participant in this study. A total of 1,500 nurses have been chosen from 3 hospitals to participate in this study. Your participation in this study is completely voluntary and no one with whom you work will know whether or not you participate.

To participate in the study you will complete the enclosed questionnaire and return it to us in the enclosed postage paid envelope. Returning your completed questionnaire connotes your consent to be a participant in this study. This questionnaire is composed of questions addressing your experiences of implementing nursing activities in your current position on your unit. Completion of the questionnaire should take no longer than 20 minutes. You are free to answer or not answer any particular question and have no obligation to complete the questions once you begin.

Your participation is also anonymous. You are asked not to put any identifying information on the questionnaire booklet. Also, for protecting your confidentiality, please do not fill out questionnaire in a public place. Once you complete the questionnaire, please return it to the researcher as soon as possible. All data obtained in this study will be reported as group data. No individual can be or will be identified. The only persons who will have access to these data are the investigators named on this letter. Every effort will be made to keep your records private.

We will not know who completed the questionnaire as there is no identifying information on them. Taking part in this research is not a part of your job duties, and refusing will not affect your job in any way. In fact, no one with whom you work will know if you do or do not participate in the study. There are neither risks anticipated should you participate in this study nor any anticipated benefits from being involved with it. However, there may be professional benefit from this study, as the information we obtain will be communicated to the profession through publication in the literature,
presentation at professional meetings and directly disseminated to professional associations. There is no cost to you or financial benefit for your participation.

You may contact me (Chang-Chiao Hung) with any questions at (07) 352-1881 or by email (dv749@email.unc.edu).

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact the Institutional Review Board at (phone number of hospital IRB) or by email to (email of hospital IRB).

Thank you for considering participation in this study.

Sincerely,

Chang-Chiao Hung, MSN
Doctoral Student
University of North Carolina at Chapel Hill
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TEL: (07)352-1881
Email:dv749@hotmail.com

Mary R. Lynn, PhD
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Dear Nursing Colleague:

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To participate in the study you will complete the enclosed questionnaire and return it to us in the enclosed postage paid envelope. Returning your completed questionnaire connotes your consent to be a participant in this study. This questionnaire is composed of questions addressing administration information (e.g., number of each level of staff on your unit), demographic, and your estimation of patient conditions and nursing activities that occur on your unit. Completion of the questionnaire should take no longer than 30 minutes. You are free to answer or not answer any particular question and have no obligation to complete the questions once you begin.

Your participation is also anonymous. You are asked not to put any identifying information on the questionnaire booklet. Also, for protecting your confidentiality, please do not fill out questionnaire in a public place. Once you complete the questionnaire, please return it to the researcher as soon as possible. All data obtained in this study will be reported as group data. No individual can be or will be identified. The only persons who will have access to these data are the investigators named on this letter. Every effort will be made to keep your records private.

We will not know who completed the questionnaire as there is no identifying information on them. Taking part in this research is not a part of your job duties, and refusing will not affect your job in any way. In fact, no one with whom you work will know if you do or do not participate in the study. There are neither risks anticipated should you participate in this study nor any anticipated benefits from being involved with it. However, there may be professional benefit from this study, as the information we obtain will be communicated to the profession through publication in the literature.
presentation at professional meetings and directly disseminated to the professional associations. There is no cost to you or financial benefit for your participation.

You may contact me (Chang-Chiao Hung) with any questions at (07) 352-1881 or by email (dv749@email.unc.edu). All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact the Institutional Review Board at (phone number of hospital IRB) or by email to (email of hospital IR).

Thank you for considering participation in this study.

Sincerely,

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dv749@hotmail.com

Mary R. Lynn, PhD
Professor and Adviser
University of North Carolina at Chapel Hill
School of Nursing
APPENDIX 3: INSTRUMENT FOR NURSES

Part 1

Please provide this information about you.

1. Gender : □ Male □ Female

2. Age : ___________ years old

3. Certificate : □ RN □ LPN

4. Highest degree : □ Master’s □ Bachelor’s □ Associate

5. Employment : □ Full-time □ Part-time

6. Type of unit : □ ICU □ General unit

7. Nursing Ladder: □ N1 □ N2 □ N3 □ N4

8. What year you were originally licensed as a nurse? ______________

9. What year you were initially hired at this hospital? ______________
**Part 2**

**Instruction:** The following statements ask about nurses’ experiences within making decisions for their patients on your unit. Please mark the answer that most closely represents your perceptions during the past three months.

<table>
<thead>
<tr>
<th>If the situation</th>
<th>Never happens, circle</th>
<th>S</th>
<th>O</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the situation</td>
<td>Sometimes happens, circle</td>
<td>S</td>
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<tr>
<td>If the situation</td>
<td>Often happens, circle</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It the situation</td>
<td>Always happens, circle</td>
<td>A</td>
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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nurses in my unit actively evaluate and provide for patients’ education needs.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>Nurses in my unit are likely to be an active participant when patient care decisions need to be made.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>Excluding physician’s orders, nurses in my unit are allowed to carry out many professional nursing activities for patients</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>4.</td>
<td>Excluding physician’s orders, nurses in my unit are allowed to decide how many times to check patients’ vital signs rather than simply following a physician’s order.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>5.</td>
<td>Nurses in my unit have fulfilled their responsibility when they report patients’ conditions to a physician.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>6.</td>
<td>When nurses have doubts about a physician’s intervention, they actively discuss it with the physician.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>7.</td>
<td>When a patient disagrees or doubts a physician’s intervention, nurses are willing to advocate on the patient’s behalf.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>8.</td>
<td>When nurses have doubts about a physician’s order, they point it out.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>9.</td>
<td>Nurses in my unit endeavor to get learning opportunities to increase the quality of patient care.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>10.</td>
<td>The physician’s opinion about nursing activities wouldn’t influence how nurses make a nursing plan.</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>11.</td>
<td>When a new policy affects the nursing plan for patients, nurses would feel free to figure out the need for change.</td>
<td>N</td>
<td>S</td>
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Part 3

**Instructions:** The following items ask about nurses’ experiences in making administrative decision in your unit. There is no judgment about managers. Please mark the answer that most closely reflects your perceptions during the past three month.

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</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Our superiors ask nurses for input on decisions that affect nurses at work.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<td>2.</td>
<td><strong>Nurses in my unit are encouraged to offer their opinions at work.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
<td></td>
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<tr>
<td>3.</td>
<td><strong>There are opportunities for nurses to have a say in the running of this institution on matters that concern nurses.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>4.</td>
<td><strong>Management responds in a satisfactory manner to what nurses have to say.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<td>5.</td>
<td><strong>From past experience at this institution, nurses feel it is a waste of time and energy to tell the management anything.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>6.</td>
<td><strong>Nurses feel comfortable about offering their opinion to supervisors at work.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>7.</td>
<td><strong>Nurses are involved in the writing of the policies at this institution.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>8.</td>
<td><strong>The quality of decisions improves as nurse participation in decision making increases.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>9.</td>
<td><strong>Participation in decision making tends to make nurses feel better about themselves.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
<td></td>
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<tr>
<td>10</td>
<td><strong>Participation in decision making tends to make nurses feel they have a stake in running the organization</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>11</td>
<td><strong>Participation in decision making tends to make nurses feel more a part of the team.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
<td></td>
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<tr>
<td>12</td>
<td><strong>Nurses should be allowed to participate in decision making in the work place on matters that affect them.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
<td>SA</td>
<td></td>
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</table>
Part 4

**Instructions:** The following statements ask about your perception of rules, regulations, and policies affecting nurses’ activities on the unit. Please mark the answer that most closely your perception in your unit.

If you **Strongly Disagree** that the item is descriptive of your perception, circle **SD**

If you **Disagree** that the item is descriptive of your perception, circle **D**

If you **Sometimes disagree/Sometimes agree** that the item is descriptive of your perception, circle **D/A**

If you **Agree** that the item is descriptive of your perception, circle **A**

If you **Strongly Agree** that the item is descriptive of your perception, circle **SA**

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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Nurses can change the rule or protocol to ensure success in their task if the unit policy cannot deal properly with questions.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td><strong>Many nursing tasks have not been standardized in unit regulations.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td><strong>On my unit, every step in a nursing task has to follow the handbook or protocol.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td><strong>Other people feel that nurses do their job in a formal and preplanned manner.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td><strong>When a problem occurs, nurses can ignore the rules and find the best way to deal with it.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td><strong>Most of the regulations and policies on my unit have been written down.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>7</td>
<td><strong>All nurses have to get permission from the head nurse before making any administration decisions.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>8</td>
<td><strong>On my unit, even quite small matters have to be referred to someone higher up for a final answer.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>9</td>
<td><strong>On my unit, nurses’ activities consist of many regulations and standard procedures.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
<tr>
<td>10</td>
<td><strong>Nurses have to ask their head nurse before they do almost anything on my unit.</strong></td>
<td>SD</td>
<td>D</td>
<td>D/A</td>
<td>A</td>
</tr>
</tbody>
</table>
APPENDIX 4: INSTRUMENT FOR HEAD NURSES

Part 1

Please provide this information about you.

1. Gender : □ Male  □ Female

2. Age : __________ years old

3. Highest degree : □ Master’s  □ Bachelor’s  □ Associate

4. Nursing Ladder: □ N2  □ N3  □ N4

5. What year you were originally licensed as a nurse? __________

6. What year you were initially hired at this hospital? __________
Part 2 Unit Data

1. Type of Unit: □ ICU □ General unit

2. Please fill in number of each type of staff on your unit
   ______ RN, ______ Nursing Assistant

3. Please fill in number of each level of staff in your unit
   ______ N1, ______ R2, ______ N3, ______ N4

4. How many medication errors based on the “Five Rights” occurred on your unit during the last month? ________________

5. How many of these fit the following categories:
   - Wrong medicine ________________
   - Wrong patient ________________
   - Wrong time ________________
   - Wrong dose ________________
   - Wrong route ________________

6. The total number of patient days during the last month on your unit was ______ days (total number of days each patient was hospitalized for the past month).

7. The total number of patient beds in your unit is ____________.
### Part 3

**Instruction:** The following questions ask about patient conditions and nursing activities that occurred on your unit during the last month. Please circle the answer which best represents your opinion on your unit.

- If the number of patient is **None** circle **N**
- If the number of patient is **Few** circle **F**
- If the number of patient is **Half** circle **H**
- If the number of patient is **Most** circle **M**
- If the number of patient is **All** circle **A**

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
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<tbody>
<tr>
<td>1. How many of the patients on your unit receive intravenous fluid treatment through a central venous line?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>2. How many of the patients on your unit receive continual sedation?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>3. How many of the patients on your unit require hourly monitoring (e.g., blood glucose checks, GCS, SpO2, vital signs)?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>4. How many of the patients on your unit require the use of technical equipment (e.g., ventilation, cardiac/telemetry monitor, pulse oximeter, patient controlled analgesia, etc.)?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>5. How many of the patients on your unit have emergencies that require immediate nursing action (e.g., myocardial infarction, cardiac/respiratory arrest, hemorrhage, or seizure)?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>6. How many of the patients on your unit require assistance with ADL’s, such as ambulation, bathing or feeding, or help to the bedside commode or toilet?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>7. How many of the patients would you say have similar nursing diagnoses on your unit?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>8. In your estimation, how many of the nurses on your unit make decisions during their work that are repetitious from one day to the next?</td>
<td>N F H M A</td>
</tr>
<tr>
<td>9. In your estimation, how much of the nursing care given on your unit relies upon nurses’ intuition rather than standard procedures or routines?</td>
<td>N F H M A</td>
</tr>
<tr>
<td></td>
<td>Question</td>
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<tr>
<td>10.</td>
<td>In your estimation, how many of the nurses change their activities in providing care to patients on your unit?</td>
</tr>
<tr>
<td>11.</td>
<td>How many of the patients on your unit have complex health problems that are not well understood?</td>
</tr>
<tr>
<td>12.</td>
<td>How many of the patients on your unit had an unplanned transfer out of your unit?</td>
</tr>
<tr>
<td>13.</td>
<td>How many of the patients on your unit have diagnoses that do not relate well to your unit (e.g., patients with an obstetrics diagnosis are in a medical unit)?</td>
</tr>
<tr>
<td>14.</td>
<td>How many of the patients on your unit have “mood” problems that cause nurses to alter their activities or treatment?</td>
</tr>
<tr>
<td>15.</td>
<td>How many of the patients on your unit or their family have an unanticipated requirement for nurses, which causes nurses to alter their activities or treatment?</td>
</tr>
<tr>
<td>16.</td>
<td>How many of the procedures or treatments that your staff are asked to provide are seldom provided by your unit?</td>
</tr>
</tbody>
</table>
REFERENCES


Lin, P. M. (2008). Hospital inpatients' medication delivery: Analysis of nursing task accuracy, workload, and capability. Master, China Medical University, Taichung, Taiwan.


Olsen, S., Neale, G., Schwab, K., Psaila, B., Patel, T., Chapman, E., & Vincent, C. (2007). Hospital staff should use more than one method to detect adverse events and potential adverse events: incident reporting, pharmacist surveillance and local real-time record review may all have a place. *Quality and Safety in Health Care, 16*(1), 40-44.


Scott, K. A. (2009). Managing variance through an evidence-based framework for safe and reliable health care. In K. Malloch & T. Porter-O'Grady (Eds.), Introduction to Evidence-Based Practice in Nursing and Healthcare (pp. 149). Sudbury, MA: Jones and Bartlett


