

SITUATION AWARENESS AND THE SELECTION OF INTERRUPTION  
HANDLING STRATEGIES DURING THE MEDICATION ADMINISTRATION  
PROCESS: A QUALITATIVE STUDY

Mary Cathryn Sitterding

Submitted to the faculty of the University Graduate School  
in partial fulfillment of the requirements  
for the degree  
Doctor of Philosophy  
in the School of Nursing,  
Indiana University

September 2014

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Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Patricia Ebright, PhD, CNS, RN, FAAN, Chair

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Marion Broome, PhD, RN, FAAN

Doctoral Committee

---

Emily Patterson, PhD

Date of Defense

July 13, 2013

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Pamela Ironside, PhD, FAAN, ANEF

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Mary Cathryn Sitterding

## ACKNOWLEDGEMENTS

I would first like to thank the direct care nurses who volunteered to participate in this study. Thank you for sharing your practice with me. Without your participation, this work would never have been possible.

Secondly, I offer a very sincere thank you to my Committee Chair, my primary advisor and mentor, Dr. Patricia Ebright. Thank you for your pioneering research describing the cognitive work of nursing inspiring many to expand upon your original and most significant work. Thank you for your profound contribution to the body of patient safety literature inspiring many. Thank you for accepting and mentoring me as your doctoral student. Thank you for seeing the potential for me to contribute to the cognitive work of nursing literature. Thank you for your generosity of time and spirit every single week to ensure the work continued even in the midst of competing priorities. Thank you for the patience of Job. Thank you for modeling excellence in qualitative nursing research.

Next, I wish to extend a most sincere thank you to my dissertation committee: Dr. Patricia Ebright, Dr. Marion Broome, Dr. Pamela Ironside, and Dr. Emily Patterson.

I have been extraordinarily privileged to learn and work with this group of exceptional researchers. I will be forever grateful for your encouragement, leadership, and constructive criticism.

I offer a special thank you to Dr. Marion Broome. Thank you for seeing in me what I never expected to have accomplished. Thank you for encouragement and wisdom in the midst of failure. Thank you for your generosity of time when time didn't exist. Thank you for holding me accountable for scholarly discourse.

I also offer a very special thank you to my family. Thank you to each and every one of my six brothers and sisters and my parents who prayed for and supported me throughout my entire doctoral program. I wish to offer a special thanks to my brother DJ for watching over mom and dad when I was busy with school. I wish to offer a very special thanks to three women in my life. First, I wish to thank my mother who has modeled faith, strength, grace, wisdom, and tenacity for all of her children and most especially to me. I wish to thank my sister, Bev, who modeled those same attributes and who found time for me when time didn't exist. I thank Bev for prayers, patience, and for modeling service to our parents, our families, and her students. I thank my daughter, Cathryn, for modeling her namesake and grandmother's tenacity, wisdom, strength, and grace. I thank Cathryn for reminding me how blessed I am to have been granted the privilege and opportunity to be a woman earning a PhD compared to so many other women in other parts of the world absent this privilege. I thank my son, Alex. I thank Alex for modeling resilience and tenacity in the midst of fire and failure. I thank Alex for modeling humility and for his ever-so-gentle reminders of life's blessings. Finally and most importantly, I thank my husband Mitch. I thank Mitch for unwavering, unconditional support every single time I shared interest in returning to school. I thank Mitch for undeserving, unconditional love and patience every day of my life including my academic journey. I will be forever thankful for you and your belief in my capacity to serve.

Mary Cathryn Sitterding

SITUATION AWARENESS AND THE SELECTION OF INTERRUPTION  
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PROCESS: A QUALITATIVE STUDY

Medication administration error remains a leading cause of preventable death. A gap exists in understanding attentional dynamics, such as nurse situation awareness (SA) while managing interruptions during medication administration. The aim was to describe SA during medication administration and interruption handling strategies. A cross-sectional, descriptive design was used. Cognitive task analysis (CTA) methods informed analysis of 230 interruptions. Themes were analyzed by SA level. The nature of the stimuli noticed emerged as a Level 1 theme, in contrast to themes of uncertainty, relevance, and expectations (Level 2 themes). Projected or anticipated interventions (Level 3 themes) reflected workload balance between team and patient foregrounds. The prevalence of cognitive time-sharing during the medication administration process was significant or may be remarkable. Findings substantiated the importance of the concept of SA within nursing as well as the contribution of CTA in understanding the cognitive work of nursing during medication administration.

Patricia Ebright, PhD, CNS, RN, FAAN, Chair

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## CHAPTER I

### INTRODUCTION AND NATURE OF THE STUDY

This chapter presents background information from research on interruption management, task-switching, and situation awareness in nursing – with a particular focus on medication administration. This chapter provides the statement of purpose for this study, definition of terms, and the hypothesized relationships among the concepts of the proposed model describing the cognitive work of nursing.

#### **Background**

In 1999, the Institute of Medicine (IOM) reported that medication errors accounted for more than 7,000 deaths annually (Kohn, Corrigan, & Donaldson, 2000). Medication administration has remained a problem resulting in 1.5 million preventable medication errors in hospitals annually (IOM, 2007).

Policymakers, payors, and the public seek an understanding of factors contributing to errors in care delivery (Ebright, et al., 2004; Vogus, et al., 2010). Medication administration is the leading cause of preventable deaths in hospitalized patients in the United States (Barker, et al., 2002; Kopp, et al., 2006; Classen, et al., 2011). Human error – described as the unintended consequences where the error is due to the actions of a human operator (Cook and Woods, 1994; Endsley, et al., 2000; Wickens, et al., 2008). – contributes to the majority of patient care harm. Attentional lapses have been associated with human error. Attentional lapses represent a major important source of cognitive deficit and are closely related to aspects of situation awareness – one of the least explored phenomena in human error research.

Research reveals that situation awareness is the greatest predictor of attention in human error and cognitive work (Endsley, et al., 2000). Interruptions and task-switching in nursing care are frequent and have been reported to contribute to medication administration error. However, a state of the science review, including 791 articles published between 2001 through 2011, proposed that beliefs about the negative effects of interruptions are more conjecture than based on empirical data. Understanding situation awareness in nursing and the potential impact of situation awareness and interruptions on human error remains unexplored. How does situation awareness impact interruption-handling strategies and task switching among nurses serving medical-surgical nursing units during medication preparation and administration?

Medication errors occur at different stages in the process. Processes and roles most fraught with error include physician ordering and nurse administration, accounting for 39% and 38% respectively. Proximal causes for nursing administration errors include lack of general knowledge of medications, misuse of infusion pumps, insufficient double-checking specific to drug and dose, and memory lapses (Leape et al., 1995). Recent literature asserts illegibility of physician medication orders and interruptions during the medication administration process as the major factors influencing preventable medication error (Wakefield, et al., 1998; Biron, et al., 2009).

Medication administration is remarkably complex – increasing the opportunity for human error – and derived from a number of elements: 1) Electronic technology within the nursing work environment; 2) Nursing workflow and facility design; and 3) A variety of policies and procedures governing the control and administration of medications (Grigg, et al., 2011). In an observational study, Grigg and colleagues (2011) documented



the intricacy of the medication administration process. Average morning medication rounds took just short of two hours but ranged from between one hour to two hours. On average, each RN administered twenty-nine medications, with a range of fifteen to fifty-two medications per morning. Additionally, each morning the average patient received six medications, but some patients needed as many as nineteen. Although the majority of medications are in pill form, no single medication round was exclusive to pills. Variation in medication routes or required forms increased nursing work complexity and the potential for error.

Types of medication error include wrong time, dose omission, wrong dose, and wrong drug (Barker, Flynn, Pepper, Bates, & Mikeal, 2002). Medication administration error studies also have been conducted primarily in specialty units such as psychiatric hospitals, adult, neonatal, and pediatric (Girotti, Garrick, Tierney, Chesnick, & Brown, 1987; Armitage, et al., 2003; Haw, Dickens, & Stubbs, 2005; Raju, Kecskes, Thornton, Perry, & Feldman, 1989; Biron, et al., 2009; Biron, et al., 2009.). Findings from these studies varied, as did the methodology, thus limiting generalization and translation at the point of care delivery.

In order to facilitate safe patient care by registered nurses, the discipline must understand how nurse attention influences interruption-handling during the medication administration process. Eighty percent of medical errors are attributed to human factors. Human error experts – outside of nursing – suggest the area of study least explored is attention, and more specifically, situation awareness. The impact of situation awareness on attention in high-hazard, demanding environments is well documented (Woods, 1994; Weick, 2007; Wickens, 2008; Cornell, et al., 2011). The topic of attention has been a

fundamental element of psychology research since World War II. Attention is one of the four main limits on human information processing (in addition to storage, memory, and response time). Of particular relevance is the study of attentional processing capacity as applied to the cognitive work of nursing, that is: 1) How many tasks can the nurse do at one time? 2) How rapidly can the nurse switch from task to task? 3) How does nursing attention influence decisions about prioritization of interruptions?

The relationship between interruptions, attention, and situation awareness and its impact on medication administration error in nursing is relatively unexplored, and may be contributing to the potential or frequency of medication error. The average nurse spends less than thirty seconds on over half of all tasks (Cornell, et al., 2011). Unexplored issues include: 1) How the nurse manages interruptions, tasks, and 2) The relationship between interruptions, tasks, and human error-related aspects of attention and situation. To date, self-reported questionnaires and observational studies have been used to gather data primarily from specialty units. Qualitative data describing human error-related elements is necessary and fundamental to understand the cognitive work of nursing and the impact on interruption selection decision-making related to the process of medication administration. Less understood is the description of situation awareness during medication administration and direct-care nurse selection of interruption-handling strategies during the medication administration process.

### **Study Purpose**

The purpose of the study is to describe situation awareness during the medication administration process including the selection of interruption-handling strategies.

## Specific Aims and Research Questions

The specific aims of the study are to:

1. Describe situation awareness during the medication administration process among direct-care registered nurses serving acute critical care and medical-surgical environments.
2. Describe the selection of interruption-handling strategies vis a vis situation awareness during the medication administration process among direct-care registered nurses serving acute critical care and medical-surgical environments.

A qualitative descriptive research design is proposed to fulfill the study's purpose (Sandelowski, 2000a). All qualitative data reflects the use of research questions to guide qualitative descriptive study, as such questions help to ensure that specific aspects of the phenomenon of interest are well-explored (Sandelowski, 1995a).

The research questions of the study are:

1. What is the description of situation awareness during the medication administration process among direct care registered nurses serving acute critical care and medical-surgical environments?
2. What is the description of situation awareness and the selection of interruption-handling strategies during the medication administration process among direct-care registered nurses serving acute critical care and medical-surgical environments?

## Definitions of Key Terms

**Task Switching:** action and or behavior moving from a primary task to a secondary task with resumption of primary task variable (Wickens, et al., 2008).

**Situation Awareness:** a dynamic process in which a nurse perceives each clinical cue relevant to the patient and his or her environment; comprehends and assigns meaning to those cues resulting in a patient-centric sense of salience; and projects or anticipates required interventions based on those cues (Sitterding, et al., 2012).

**Interruption:** a break in the performance of a human activity initiated by a source internal or external to the recipient, with occurrence situated within the context of a setting or location. The break results in the suspension of the initial task by initiating the performance of an unplanned task with the assumption that the initial task will be resumed. Types of interruptions are defined as:

1. Intrusion – unexpected encounter initiated by another person that interrupts flow and continuity of an individual’s work and brings that work to a temporary halt.
2. Distraction – psychological reactions triggered by external stimuli or secondary activities that interrupt focused concentration on a primary task; generally instigated by competing activities or environmental stimuli that are irrelevant to the task at hand.
3. Break – planned or spontaneous recesses from work on a task that interrupts the task flow and continuity.
4. Discrepancy – perceived inconsistencies between one’s knowledge and expectations and one’s immediate observations that are perceived to be relevant to both the task at hand and personal well-being. (Brixey, J. et al., 2007 p. E 38).

**Categories of Interruptions** are defined as:

1. Intended recipient (person to be interrupted).

2. Unintended recipient (not the intended recipient of the interruption; i.e. receiving a phone call that was incorrectly dialed).
3. Indirect recipient (the incidental recipient of an interruption; i.e. talking with a person who was interrupted that resulted in the suspension of the conversation).
4. Self-interruption (a person independent of another person suspends an activity to perform another; i.e. while walking stops abruptly to talk to another person).
5. Distraction (briefly disengaging from a task).
6. Organizational design: (disruption in workflow caused by flaws in the physical layout of the workspace).
7. Artifacts not available (disruption in workflow caused by a need to procure supplies and equipment not available in the workspace).
8. Initiator: the originator of an interruption. (Brixey, et al., 2008 p. 7)

**Interruption-Handling Strategies:** two classes of interruptions handling strategies include one that allows the interruption (engaging, multi-tasking, or mediating), and one strategy that blocks the interruption. A taxonomy (Colligan, L. and Bass, E., 2012) describes the three allowance and one blocking strategies.

Types of Interruption-Handling Strategies (Colligan, L. and Bass, E., 2012) are:

1. Engaging: high priority secondary task. The primary task is suspended so that the higher priority secondary task may be engaged immediately. The primary task may be resumed after completion of the secondary task.
2. Multi-tasking: similar priority primary and secondary tasks. The interrupted person multi-tasks by dividing attention between the primary and secondary tasks; both tasks are performed synchronously.

3. Mediation: high priority task generated before suspension of primary task. The interrupted person mediates the interruption with an action that supports resumption of the primary task. Mediation measures usually support prospective memory (memory that we need to make actions in the future), mark the state of task or complete a subtask of the primary task before switching tasks. Sometimes the interrupted person mediates the interruption by deflecting the secondary task to another worker. In this case, the task of delegation is the high priority task that is generated.

4. Blocking: high priority primary task. Primary task takes priority over the secondary task and the secondary task is blocked.

### **Significance and Contribution**

Medication administration error remains the leading cause of preventable death in hospitals. The complexity of the nursing work environment, including the frequency of task switching and interruptions, is well documented (Brixey, J. et al., 2007; Westbrook, et al., 2010; and Cornell, et al., 2011). The gap in nursing knowledge is the understanding of attentional dynamics such as situation awareness in managing interruptions during medication administration. This study will address the aforementioned gaps in the literature by examining situation awareness and the cognitive work of nursing observation, videography, and applied cognitive task analysis. The study will describe situation awareness and the selection of interruption-handling strategies prior to and during medication administration among direct-care nurses serving critical care and medical-surgical units within Magnet hospitals. The results of this study may contribute the taxonomy defining interruption-handling strategies (Colligan, L. and Bass, E., 2012),

which could serve as a basis for explanatory research – ultimately informing quantitative studies and the design of interventions to influence nurses’ situation awareness and decision-making during medication administration. The proposed study is depicted in Appendix A, titled The Experience of SA, Interruption-handling Strategies, and Medication Administration.

### **Chapter Summary**

The urgency to understand and mitigate factors influencing interruptions in nursing and safe medication administration is well documented (McGillis, et al., 2010; Redding, et al., 2009; Hall, et al., 2010). There is a need to understand direct-care nurse situation awareness in the selection of interruption-handling strategies during the medication administration process; these things are not well understood within nursing practice.. In order to reduce human error, the discipline needs to understand what factors influence situation awareness in nursing and to describe, explain, and/or predict why a nurse might select a particular interruption-handling strategy during the medication administration process. Answering these questions may inform design of strategies to enhance situation awareness and allowance of only patient-centric, value-added interruptions during medication preparation and administration. The discipline’s obligation to policymakers, payors, and the public demands a reduction in preventable deaths during the medication administration process (Classen, et al., 2011), thus supporting the study purpose, research question and proposed design.

CHAPTER II  
REVIEW OF THE LITERATURE

**Introduction**

During the qualitative inquiry, the researcher will perform a literature review to uncover current knowledge and data regarding the particular phenomena of interest (Sandelowski, 2000). The goal is to discover research already conducted related to the study of nurse interruptions related to medical errors, and also to identify areas where there is a lack of information. The findings of the qualitative inquiry will help narrow the study's focus and purpose, in addition to help formulate research questions and the study's design. This literature review will clarify the phenomenon under investigation and provide rationale for selecting a qualitative approach. A successful review of the literature will identify what is known about the study focus, and also will help identify what remains unexplored. In this case, the literature reviewer examined patient care safety and medication error, the cognitive work of nursing and specifically the experience of interruption management, and situation awareness.

The reviewer used a variety of databases for the literature review and used key words and phrases such as situation awareness, interruption management, patient care error, and task management. Databases included MEDLINE, CINAHL, PsycINFO, and academic databases from Ebsco, Gale, ProQuest, and CSA. The review focused on the disciplines of medicine, nursing, psychology, sociology, business, aviation, and defense. The time period studied began at the database inception through March 2011. Results were limited to the English language. By examining reference lists, the reviewer



discovered related work from industries outside of medicine such as aviation, driver training, military, firefighting, and nuclear power plant operations.

There is an abundance of written materials and studies related to patient safety and medical errors, but not all of it relates to the focus of this research. During the review, it was important keep key questions in mind: 1) What is the nature of patient care safety and medication administration error? and 2) What is the nature of interruption management and situation awareness in nursing work?

Ultimately, the goal was to review the conceptual, theoretical, and methodological challenges and successes associated with studying interruptions and situation awareness among nurses administering medications within adult medical-surgical and critical care environments. Priority areas of review included:

- Patient care safety and medication administration errors.
- Scholarly nursing contributions in patient safety.
- Situation awareness in nursing and influencing factors.
- Proposed conceptual framework hypothesizing the relationship between

interruption management, task-switching and situation awareness on the cognitive work of nursing.

### **Patient Care Safety: Medication Administration Errors and the Impact on Society**

More people die annually from medical errors than they do from breast cancer or AIDs, and one in five Americans (approximately 22.8 million people) report experiencing a medical error (Classen, et al., 2011). The same report found that medical errors are ten times greater today than in 2000, when they were previously measured and reflected in the Institute of Medicine (IOM) report (Classen, et al.,2011).

To further demonstrate the impact medical errors have on patients and society, consider that per adult patient, for every 100 days in the ICU, 11.3 medical errors are made, and there are 2.04 adverse events (Cohen, et al., 2005). In the neonatal critical care unit, a study found 74 medical errors per 100 admissions. 56% of medical errors are preventable (Sharek, et al., 2011). It is the preventable errors that need to be further investigated. Without understanding the core cause of the errors, it is not possible to be able to make positive, sustainable improvements.

Medical errors impact patients and their families, but they also dramatically impact health care costs for society. The public and the payor concerns about the rising costs of healthcare have grown over the last several years. The cost per patient, per error, is between \$95 and \$2,640 (Cohen 2007). These numbers paint a dismal picture for the healthcare environment.

### **Patient Care Safety: Medication Administration Error Significance**

It is alarming errors during medication administration are overwhelmingly underestimated (Classen, et al., 2011). One study suggests there is one medication error for every five doses administered (Kopp, et al., 2006). Medication administration is a complex, interdependent, interdisciplinary process fraught with variability contributing to 1.5 million errors (IOM, 2007), and 7,000 deaths in hospitals annually (IOM, 2000).

Nurses work in a high-stress environment that includes myriad of complexities, , including:

- Number of medications available,
- Number of medications prescribed to hospitalized patients,
- Lack of reconciliation of medications between transitions of care

- Electronic technologies within the nursing work environment,
- Nursing workflow and facility design, and
- Numerous policies and procedures that govern the control and administration of medications.

One study that examined medication administration in thirty-six hospitals revealed that 19% of medications administered involved errors, adding to forty adverse drug events per day in a 300-bed hospital (Barker, et al., 2002). Within the acute-care environment, a nurse will administer fifteen to fifty-two medications during morning rounds spending between an hour and two hours. While some patients do not require medications, others may be prescribed as many as nineteen different medications.

What causes errors to be made during medication administration? Research is limited, so a comprehensive list of the causes does not exist. We do know physician orders are often illegible (although the increased implementation of electronic physician order entry is expected to reduce these errors; this factor is not part of this study). Another factor is interruptions nurses face prior to and during medication administration. The correlation between medication administration errors and frequent interruptions during the medication administration process is noteworthy. Among ninety-eight nurses observed on six nursing units, 4,271 medications for 720 patients were prepared in 505 hours. Nurses were interrupted 53.1% of the time while administering medications. Procedural error was observed in 74% of the drug administration processes (Westbrook, et al., 2010). Biron and colleagues (2009) observed 374 work interruptions (WI) during medication administration observation over fifty-nine hours. Assuming the potential impact of interruptions on nurse attention, this recorded frequency of interruptions is

alarming. A 2010 study by Trobovich and colleagues looked at interruptions during chemotherapy administration. The greatest interruption came during IV push, where nurses were interrupted 117% of the time (a nurse may have been interrupted multiple times during a single task). The study also found that nurses were interrupted about 60% of the time while taking vital signs, and they were interrupted 57% of the time during drug verifications.

Another study (Biron 2009) looked at the characteristics of nursing work interruptions during the medication preparation and administration phases. This study found the nurse's colleagues caused the most frequent interruptions during the preparation of medications for delivery to the patient. System failures, such as missing medications, also caused considerable interruptions. Knowing that system failures are a significant "interrupter" resulting in medication administration error may incentivize hospital administrators to solve or mitigate these system failures.

In contrast, the most frequent nursing work interruptions during the administration process are self- and patient-initiated (Biron, et al., 2009). The study found that, on average, nurses were interrupted every ninety-two seconds to attend to the patient, before resuming with the medication administration. An understanding of scholarly contributions that explain the nature of interruptions in nursing work is necessary to understand what is known and what remains unexplored and requires further research.

### **Patient Care Safety: Interruptions**

Evidence review of nursing work interruptions and the impact on medication administration error is proposed, but not well documented (Hopkinson and Jennings,

2012; Pape, et al., 2003; Biron, et al.,2009; Rivera-Rodriguez, et al., 2009; Grundgeiger and Sanderson, 2009; Relihan,et al., 2009, Anthony, et al., 2010; Westbrook, et al., 2010; Westbrook, et al., 2010). A more recent observational study verifies the cognitive cost of interruptions on working memory and the cognitive work of nursing (Redding, et al., 2009; Grudgeiger, et al., 2010; Westbrook, et al., 2010; Cornell, et al., 2011). Some early studies suggested interruptions may enhance a nurse's capacity to gain new information, but more recent literature negates those early hypotheses (Brixey, et al., 2007).

### **Interruptions in Nursing**

Interruptions occur for many reasons in acute care nursing. Nurses experience an average of 8.4 work system failures or interruptions every eight-hour shift (Tucker, et al.,2006). Interruptions complicate and lengthen the amount of time a nurse needs to complete tasks; consider, for example, that average task times observed range from less than thirty seconds for more than 50% of tasks (Cornell, et al., 2011) to 3.1 minutes with mid-task interruptions (Tucker, et al., 2006). Some interruptions are not avoidable – tending to an immediate patient need, for example – while some are caused by system failures, which include order systems failure, supply failures, staffing issues, and medication systems failures. System failures may be initiated by colleagues, phone calls, and even patients' visitors, who initiate conversations with nurses that enter the patient room to administer medication. This study will focus on auditory and visual interruptions that occur prior to and during medication administration.

Noise plays a role in interruptions as well; according to the Environmental Protection Agency (EPA), the average hospital noise level should not exceed 45 decibels (dB). Peak, abrupt sound levels in one hospital study measured at 113 dB, slightly louder

than a jackhammer (Cmiel, et al., 2004). Noise interruptions in acute care hospitals include clinical alarms, overhead pages, call bell systems, meetings, conversations, and heating and cooling systems.

### **Interruptions Defined**

Defining attributes of interruptions in nursing include the following: human experience, secondary intrusion, discontinuity, externally or internally initiated, and situated within context (Brixey, et al., 2007). Empirical referents that quantify interruption include frequency of an interruption, number of times the primary task has been suspended to perform the interrupting task, the length of time the primary task has been suspended for the interruption, and the frequency of returning to the primary task. (Brixey, et al., 2006). Some investigators have described and quantified provider response to interruptions in a range from one to nine, where one is a potentially distracting source such as a beeper, and nine is operation flow actually interrupted (Healey, et al., 2006).

Definition, categories, types, and a taxonomy for interruption-handling strategies are discussed as follows.

Brixey (2007) provides the most widely cited definition for interruption. Interruption is defined as “a break in the performance of a human activity initiated by a source internal or external to the recipient, with occurrence situated within the context of a setting or location. The break results in the suspension of the initial task by initiating the performance of an unplanned task with the assumption that the initial task will be resumed.” (Brixey, J. et al., 2007 p. E 38).

Categories of interruptions in healthcare include:

- Intended recipient (person to be interrupted purposefully),
- Unintended recipient (not the intended recipient of the interruption; i.e. receiving a phone call that was incorrectly dialed),
- Indirect recipient (the incidental recipient of an interruption; i.e. talking with a person who was interrupted that resulted in the suspension of the conversation),
- Self-interruption (a person independent of another person suspends an activity to perform another; i.e. while walking stops abruptly to talk to another person),
- Distraction (briefly disengaging from a task),
- Organizational design (disruption in workflow caused by flaws in the physical layout of the workspace),
- Artifacts not available (disruption in workflow caused by a need to procure supplies and equipment not available in the workspace), and
- Initiator – the originator of an interruption (Brixey, et al., 2008 p. 7)

### **Types of Interruptions**

According to Jett (2003), there are four categories:

1. Intrusion is an unexpected encounter initiated by another person that interrupts flow and continuity of work bringing work to a temporary halt. Intrusions are the most common interruptions.
2. Distraction is described as a psychological reaction triggered by external stimuli or secondary activities that interrupt focused concentration on a primary task: generally instigated by competing activities or environmental stimuli that are relevant to the task at hand.
3. Breaks are planned or spontaneous recesses from work on a task that interrupts the task flow and continuity.

4. Discrepancy is described as perceived inconsistencies between one's knowledge and expectations and one's immediate observations that are perceived to be relevant to both the task at hand and personal well-being (McGillis, Hall, et al., 2008).

Colligan and colleagues (2012) propose an integrated taxonomy for describing interruption management consistent with the cognitive work of nursing framework proposed by Ebright and Sitterding (2011). A taxonomy for interruption-handling strategies includes one strategy to block the interruption and three strategies to allow and handle the particular interruption (Colligan and colleagues, 2012 in press p. 5). The strategies include:

- Blocking strategy – based upon the perception that the nurse is engaged in a high-priority task that cannot and will not be interrupted.
- Allowing – engaging strategy is used to address a high-priority, secondary task.
- Allowing – multi-tasking is based upon the perception that the secondary task is of equal priority of the primary task.
- Allowing – mediating means a higher-priority task is generated before suspension of the primary task.

### **Interruptions Measurement**

Recent literature, combined with twenty-three case studies analyzed in 2009, suggests the most common method to measure interruptions has been through observational study (Biron, et al., 2009; Westbrook, et al., Brixey, et al., Biron, et al., Cornell, et al., 2011). Self-reporting and focus groups have verified the relationship between perceived workload and interruptions (Biron, et al. 2009; Westbrook, et al.



2010). There is a lack of research that examines the type and quantity of interruptions, in addition to what triggers a nurse to respond to the interruption and let it interfere with the primary task. The measurable impact of interruptions and task switching on the cognitive work of nursing includes working memory, situation awareness, and clinical reasoning in transition is inferred but without evidence (Cornell, et al., 2011; Biron, et al., 2009; Brixley, et al., 2007; Wickens, et al., 2008).

Research findings regarding the impact of interruptions on patient care safety, medication administration, and nursing work have been primarily descriptive with limited evidence of the causal relationship between interruptions and patient care errors. For example, one study examined the process of medication dispensing and the subjective impression of interruptions and the related impact on pharmacists (Grundgeiger, et al., 2009). Further limiting the research is the fact that the majority of studies vary in how interruption is defined, coupled with methodological weaknesses. The urgency to understand and mitigate factors influencing nursing attention, interruptions, and safe medication administration is well documented and should inform research design.

Colligan (2012, in press) argues cognitive tasks are not easy to resume after interruption. Although checklists and notes are common, there is no way to “place-hold” a cognitive task. For example, checking an unfamiliar medicine is a greater cognitive “load” than checking a familiar medication, such aspirin. Colligan and colleagues (2012, in press) found nurses performing higher cognitive load tasks are more likely to block interruptions. When they must engage with an interruption (task switch), the cognitive task is often resumed from the beginning, which is inefficient (Colligan and Bass, 2010).

Interruptions compound the amount of information being processed. If the demands for cognitive resources are higher than those available, task performance is negatively affected (Wickens, et al., 2000). Task performance can be negatively affected by interruptions due to the relationship between task performance, interruptions, and situation awareness (Wickens, et al., 2000; Endsley, 2000). When interruptions occur as a result of an increased workload, demands for cognitive resources also may result in a significant strain on situation awareness. By reducing limited working memory and by limiting the amount of new information that can be gathered to make decisions, decisions can be made without taking into account all the information available; thus potentiating human error influencing medication administration error. Numerous studies have contributed to the body of knowledge quantifying interruptions in nursing (Brixey, et al., 2005, 2007, 2008; Redding, et al., 2009; Biron, et al., 2009; Grudgeiger, et al., 2010; Westbrook, et al., 2010; and Cornell, et al., 2011). Observing how nurses experience and handle interruptions could provide new insight into the cognitive processes affected by interruption.

### **Attentional Dynamics Influencing Nursing Care and Patient Care Safety**

Qualitative, ethnographic research (Ebright, et al., 2003; Ebright, et al., 2004; and Potter, et al., 2005) introduced nursing to attention, work complexity patterns, and cognitive factors driving nursing performance and decision-making strategies. Ebright (2003, 2004, 2009) introduced the concept of “Registered Nurse stacking,” which is defined as “a dynamic cognitive decision-making process resulting in care delivery priorities, and dependent on the ability of the nurse to be mindful and engage in accurate sense-making about clinical and workflow data in the midst of unpredictable and

constantly changing situations.” In other words, the nurse “stacks” their priorities in a complex environment: What happens when they are interrupted?; and How does that affect the primary task?

Potter (2005) illustrated work complexity patterns in what she described as the cognitive pathway, or a step-by-step account of each nurse’s activities that then categorized according to the nursing process. Potter defined a cognitive shift in nursing as “a shift from one patient to another during the conduct of the nursing process.” Her study found the average nurse experienced nine cognitive shifts per hour. How a nurse manages these cognitive shifts is influenced by complexity patterns that include: conflicting goals, obstacles, hazards, data, and behaviors (Ebright, 2003, 2004; Potter, 2005; Tucker, 2004, 2006, 2007).

### **The Role of Working Memory**

Working memory is a distinguishing factor differentiating high and low levels of attention and situation awareness. It is noteworthy that the literature implies a relationship between knowledge or experiential learning, working memory, and situation awareness. There is a consistent theme of differentiating the expert versus the novice when it comes to attention and situation awareness. Novices – in any industry or discipline – have limited working memory to digest multiple sources of information, then interpret and project the future scenario based upon that information. Humans – including nurses – have a limited amount of memory bank (Endsley, 2003). Most people are limited in the amount of information they can retain. Endsley’s study found people can hold an average of seven (plus or minus two) tranches of information within their working or short-term memory. Maintaining situation awareness requires key pieces of information

to reside in memory. A nurse scanning this information and combines it with new information; this is a process referred to as “chunking” (Endsley, 2003). In most cases, relying on memory alone results in significant error, because stressors significantly decrease our ability to scan the environment detecting information necessary to notice. Stress can cause the memory bank to prematurely close (Endsley 2003). So under stress, people are less likely to gather information, and therefore arrive at a decision without considering all available information.

### **Cognitive Workload**

The influence of cognitive or mental workload on attention and situation awareness are recurrent themes in the literature (Wickens, 2008; Weick, 2007, Benner, 2009). Cognitive overload is an interpretation that people make in response to breakdowns, the interruptions of ongoing projects, or an imbalance between demand and capacity (Wickens, 2008; Benner, P., 2009; Weick, K., 2009). The interpretation of overload is affected by the situation at hand – making sense of the interruptions and levels of expertise (Weick, 2007; Benner, 2009). Expertise, task management, and interruption management all influence cognitive overload, affecting attention and situation awareness. An observational study revealed the average registered nurse changes location thirteen times within an hour, shifting attention among patients every six minutes with an average of three and four interruptions per hour (Wolf, et al., 2006). Support requirements that apply to cognitive work include the following:

1. **Observability:** the ability to form insights about a particular process – overcomes the keyhole effect allowing the practitioner to see sequences and evolution over time – future activities, patterns, and relationships in a process.

2. Direct ability: the ability to direct and/or redirect resources, activities and priorities as situations change and escalate and allows the practitioner to effectively control the processes in response to or in anticipation of changes in the environment.
3. Teamwork with other cognitive agents: the ability to coordinate and synchronize activities across agents, and between agents so the practitioner effectively redirects agent resources as situations change.
4. Directed attention: the ability to re-orient focus in a changing world, which includes tracking others' focus of attention and their ability to interrupt.
5. Resilience: the ability to anticipate and adapt to surprise and error including issues such as failure-sensitive strategies, exploring outside the current boundaries or priorities, "overcoming the brittleness of automation"  
(Patterson, et al. 2010, p. 256)

### **Task Switching**

The bi-directional relationship between task management, task switching, attention, and situation awareness in nursing is relatively unexplored. Applied attention theory (Wickens, et al., 2008) suggests task management is influenced by task switching. Factors influencing the decision to task switch include: 1) Urgency: how much time is needed to complete the primary task and meet the deadline; 2) Importance: consequences of not doing the task; 3) Duration: the longer-duration tasks increase in urgency if not performed; and 4) Switching or interruption cost: a high cost will deter the nurse from task switching. Colligan et.al (2012) discovered similar factors influencing the decision to task switch in nursing during medication administration. Task-related factors include

the perceived urgency of the task, the dynamics of the task, medication-specific factors, patient-specific factors, and task-specific factors, i.e., some tasks are easier to suspend than others (Colligan, et al., 2012, in press). Although relatively unexplored in nursing, the aviation industry pioneered the study and design of solutions that influence task management and the related impact on attention and situational awareness (Wickens, et al., 2008).

Task management and interruption-handling influence the cognitive work – and overload – of the nurse. A recurrent theme in the literature is the influence task management on cognitive or mental workload and situation awareness. The impact of ineffective task management and cognitive overload on nursing attention and situation awareness is remarkable and often results in inattentional or change blindness.

Inattentional blindness is the failure to notice something here and now, in contrast to change blindness, which is the failure to notice that something is different. Both are failures of attention. Inattentional blindness can affect whether a nurse notices or responds to changes in patient conditions, anticipates or is able to contain hazards. Research(Lee, et al., 2008; Endsley, 2003), suggests study participants often fail to notice an unexpected stimulus placed directly in front of them while they are performing a particular task.

A commonly identified solution to combat ineffective task management is making a checklist. However, during unexpected or unusual work circumstances – such as those in a healthcare environment – checklists typically are rendered ineffective, because the nursing work environment is an interdependent environment, demanding multi-tasking and the capacity to manage the unexpected.

## **Situation Awareness: A Pilot Study for a Hybrid Concept Analysis**

(Note: The following section represents a manuscript published in February 2012, contributing to this dissertation.)

Pilot research was conducted to examine situation awareness among nurses working in acute care organizations. It is important to understand situation awareness in nursing, because nursing attention is required to understand a clinical situation. This has been recognized as the starting point for thinking-in-action in nursing (Benner, et al., 2000). An understanding of situation awareness in acute care nursing and identification of factors that influence situation awareness can lead to the implementation of interventions to maximize nurse attention and, specifically, situation awareness. Deepening the field's understanding of situation awareness in nursing will eliminate gaps in knowledge about attention and may improve the design of healthcare structures and processes that support nursing work and reflect an understanding of the relationship between attention in nursing and patient care error.

### **Methods**

Sitterding and colleagues (2012) selected a hybrid concept analysis as the research method to explain situation awareness in nursing. The hybrid concept analysis allows for inclusion of the nurse's perspective, which is unique to this area of study. This particular method integrates theoretical analysis and field experience, incorporating the perspective of the nurse participant. The hybrid model has been useful in defining other concepts relevant to nursing, including mental health nursing, self-care management, oncology nursing, and pediatric nursing. The hybrid concept model is comprised of three

phases: 1) The theoretical phase; 2) The fieldwork phase; and 3) The analytic phase (Schwartz-Barcott, D & Hesook, SK, 2000).

### **Sample**

Qualitative analysis of semi-structured interviews of a convenient, purposive sampling technique was used to assure representation from expert, competent, and advanced beginner direct-care registered nurses serving inpatient nursing units representing three Magnet hospitals. These included a large community hospital, an academic medical center, and a children's hospital.

### **Results**

Hybrid content analysis resulted in the emergence of patterns and themes. Situation awareness among direct-care nurses in the midst of situations of criticality and the interactive experience of additional themes emerged in the analysis. Nine themes emerged: perception, comprehension, projection, knowledge and expertise, cognitive overload, interruption management, task management, instantaneous learning, and cognitive stacking.

The researchers then used relational analysis to explore the relationships among the concepts identified and identified five main themes, most accurately illustrated in relationship with situation awareness (SA): SA and expertise, SA and cognitive overload, SA and interruption management, SA and task management, and SA and cognitive stacking. (Sitterding, et al., 2012).

### **Pilot Study Conclusions**

The conclusions of this pilot study are consistent with other studies revealing the knowledge and skills inherent in the three levels of situation awareness. Knowledge and



expertise, interruption, and task management emerged as factors contributing to situation awareness among nurses in the literature, the cross-discipline studies, and fieldwork. Cognitive overload as a potential contributing factor influencing SA was revealed through fieldwork analysis. Relational content analysis identified the interactions among the five themes. A revised definition of situational awareness in nursing is proposed: A dynamic process in which a nurse perceives each clinical cue relevant to the patient and his or her environment; comprehends and assigns meaning to those cues resulting in a patient-centric sense of salience; and projects or anticipates required interventions based upon those cues. (Sitterding, et al., 2012 p. 89).

### **Conceptual Framework: Cognitive Work of Nursing (CWN)**

The invisible or cognitive work of the individual nurse has been examined primarily through observation and interview techniques (Ebright, 2003, 2004; Potter, 2005; Tucker, 2004, 2006, 2007). Ebright and Sitterding proposed a framework— called the Cognitive Work of Nursing (CWN)—that describes, predicts, and explains the cognitive work of nursing, including the influence of interruptions and task switching on situation awareness. The proposed framework includes six major concepts and three minor concepts. The major concepts within the cognitive work of nursing framework are:

1. Work complexity contributors;
2. Clinical reasoning-in-transition;
3. Cognitive stacking;
4. Clinical judgment;
5. Nursing practice; and
6. Patient, nurse, and system outcomes.

Minor concepts with the model include:

1. Knowledge-in-context;
2. Expertise; and
3. Situation awareness.

### **Work Complexity Contributors**

Work complexity contributors are a major concept in the conceptual framework, and are defined as actual demands in the practice field that affect the behavioral and cognitive care delivery work of RNs. Studies on the practice of nursing have reported numerous work complexity contributors that challenge the successful management of work that is essential for safe and quality care (Cornell, et al., 2010; Ebright, et al., 2004; Hall, et al., 2010; Kalisch, 2009; Krichbaum, 2007; Potter, 2005; Tucker, et al., 2002; and Westbrook, et al., 2008).

The most frequently reported work complexity contributors influencing nursing practice are operational failure of equipment or supplies, flawed facility design, inadequate communication and documentation, staffing or staffing mix patterns, medication management complexity, complicated or irrelevant policies, response time, and task management (Tucker, 2006). For example, Tucker (2006) discovered the remarkable impact of operational failures on nursing work was observed among twenty-six nurses within nine hospitals where 194 operational failures were observed (on average of one failure every seventy-four minutes at an estimated cost of \$117 per failure). The average nurse was found to complete eighty-four tasks per shift, with tasks taking an average just over three minutes per task. The nurse task switched, cognitively shifted, between patients every eleven minutes and was interrupted mid-task up to eight times per

shift. Cornell et al. (2010), found in a study of twenty-seven nurses over a four-week period during actual work and 98.2 hours of observation that 77% of each of the recorded activities by nurses lasted less than thirty seconds. This demonstrates the frequent shifting of nurse activities, and nurses' attention.

### **Clinical-Reasoning-in-Transition**

The second major concept in the proposed framework – clinical reasoning-in-transition –is dependent on the processes of critical thinking and problem-solving imposed by ongoing and dynamic work complexity contributors the RN encounters throughout actual care delivery. Clinical reasoning has been defined as: “The processes by which nurses and other clinicians make their judgments, and includes both the deliberate process of generating alternatives, weighing them against the evidence, and choosing the most appropriate, and those patterns that might be characterized as engaged, practical reasoning”(Tanner, C., 2006). Reasoning-in-transition has been defined as: “Practical reasoning where a clinician takes account of gains and losses in understanding a situation as transitions occur” (Benner, et al., 1999).

Other definitions of clinical reasoning are similar in their focus on problem-solving for patient needs by clinicians (Fonteyn, M, et al., 2000). The use of the term “clinical-reasoning-in-transition,” in this framework was chosen to emphasize an additional purpose and focus for most, if not all, decision-making that RNs do while in the midst of actual care delivery situations or, for the purpose of managing workflow over a specific time period.

Ebright and Sitterding propose that even judgments about order and priority of work activities are embedded in the reasoning about clinical indicators of patient status

and needs at any point in time. Judgments about organizing and prioritizing are influenced by generating alternatives about timing and degree of completeness of delivering care activities across multiple patients and environmental demands, and by the effect of those judgments on safety and quality.

Clinical reasoning-in-transition requires a nurse to notice subtle changes in a patient's condition over time as well as in the context of environmental demands. Ebright and Sitterding (2010), propose that clinical reasoning-in-transition in actual work situations is clinical reasoning over a specific time period for multiple patients' needs and problems in addition to families' needs and problems, and informed by obvious and subtle changes in the dynamic surrounding environment, including status of all coworkers. As such, clinical reasoning-in-transition is pertinent to the safe and effective delivery of care to individual patients and groups of patients and includes management of workflow. The effectiveness of clinical reasoning-in-transition is proposed in the framework to depend on three important cognitive factors that determine how practitioners deliver care: 1): Knowledge in context; 2): Situation awareness; and 3) Management of competing goals.

### **Knowledge in Context**

Knowledge in context relates to the process by which practitioners use knowledge effectively in actual work situations (Cook, et al., 1994). Three aspects of knowledge in context are important to consider in understanding the challenges relative to RNs using knowledge as needed. These aspects include:

1. The knowledge that RNs possess.

2. How the nurses organize their knowledge to make inferences about what is happening.
3. What they expect to happen, and what can happen; and the extent to which knowledge can be activated in a specific situation.

Knowledge on-hand for managing clinical situations depends on, in addition to the RN's individual cognitive capacity, her or his education, continuing education, and previous experiences, as well as information available in the actual situation (Ebright, et al., 2003). RNs reported using three types of knowledge, which influenced their decision-making while delivering care:

1. Specific patient disease conditions (i.e., symptoms of myocardial infarctions).
2. Knowledge unique to individual patients (i.e., that the patient is blind and needs assistance with medications).
3. Knowledge about unit routines and staff (i.e., that physician rounds are usually completed by 10 a.m. or that specific nurses are easy to work with).

Whether or not the RN organizes knowledge effectively for unexpected situations depends on the completeness and accuracy of information and on the knowledge available. Practitioners organize information into mental models or representations to make inferences about the current situation (Klein, G, 1998). In a situation in which the RN has inadequate knowledge due to inexperience or to inaccurate or missing information, misunderstanding of the situation may occur, resulting in subsequent decisions that lead to unintended outcomes. For example, a nurse's judgment to resuscitate an elderly terminal patient as a result of inaccessible information on code status may result in poor outcomes for the patient, the patient's family, and the healthcare

team. The RN may have had no alternative in the actual work situation; given the information available and the urgency of the situation, however, the nurse was able to make a judgment on how to respond.

The third aspect of knowledge in context is the ability “to call it to mind when it is relevant to the problem at hand and whether he or she knows how to use this knowledge in problem-solving” (Cook, et al., 1994). Although having an accurate mental model or representation of a situation is crucial for effective intervention, maintaining and correcting representations also are essential for the dynamic situations encountered by RNs in delivery of clinical care. Cognitive work is evident in the nurse who is constantly problem-solving by adding, subtracting, and reordering priorities as patients or work conditions and operational failures (work complexity contributors) warrant. Partitioning (bundling tasks among several patients), interweaving (providing care for multiple patients in cyclical fashion, i.e., repeated task switches among patients, as opposed to providing care in a non-overlapping manner), and reprioritization (continually adapting work plans) identified as care management strategies are used by nurses to manage their workload.

### **Situation Awareness**

Situation awareness, the second cognitive factor affecting clinical reasoning-in-transition and a sub-concept in the model, is imperative for accurate decision-making in the midst of frequent cognitive shifts. Literature has been reviewed with a proposed definition following preliminary study and the conduct of a hybrid concept analysis examining situation awareness in nursing work (Sitterding, et al., 2012). Situation awareness in nursing as a sub-concept within the RN CWN framework is defined as, “A

dynamic process in which a nurse perceives each clinical cue relevant to the patient and his or her environment; comprehends and assigns meaning to those cues resulting in a patient-centric sense of salience; and projects or anticipates required interventions based on those cues (Sitterding, et al., 2012 p. 89).

### **Managing Competing Goals**

When someone must manage competing goals, she or he must use informed intuitions in decision-making about how to act, whether it means resolving conflicts, coming to a resolution or agreeing to a tradeoff. Tradeoffs represent how the RN copes with different goals that conflict in the midst of uncertainty, risk, and the pressure of limited resources (Cook, et.al, 1994). Managing competing goals captures the clinical reasoning-in-transition problem-solving around what needs to be done first, what can wait, and to what extent care delivery activities can be performed according to organizational and/or personal standards given competing goals. For example, the RN who wants to provide pain medication for a patient, respond to a team member who has requested help with a patient transfer, and needs to take a phone call from a physician regarding discharge orders for another patient must problem-solve about which goal to accomplish first. That requires the nurse to consider the context of the uncertainty, risk, and limited resources surrounding these competing goals. Managing competing goals includes organizational, patient care, and personal goals.

Personal goals also may compete with patient care and organizational goals. Consider the new graduate who is conflicted about whether to perform according to standards learned in school or to adopt the routines she perceives as universally accepted by her new colleagues on the care unit she has joined. Research suggests a relationship

between the self-generated and sometimes externally-generated social pressure experienced by new graduates and its impact on their care delivery judgments (Ebright, et al., 2004).

A previous study about nurses' competing goals in specific care delivery situations revealed goal patterns that fell into seven categories: maintain patient safety, prevent getting behind, avoid increasing complexity, appear competent and efficient to coworkers, maintain patient and family satisfaction, maintain patient flow, and get everything done (Ebright, et al., 2003).

Maintaining patient safety and patient/family satisfaction is an RN goal, which seems clear and consistent with what healthcare customers and administrators would desire. Four of the other goals are related to organization and completion of work (prevent getting behind, avoid increasing complexity, maintain patient flow, and get everything done), and reflect aspects of the clinical reasoning-in-transition process when bounded by a specific time period. Attainment of all the other goals will, to some extent, determine accomplishment of the last goal, appearing competent and efficient to coworkers. Traditional nursing education and continuing education have focused on those goals related to clinical care.

In the context of actual care situations and clinical reasoning-in-transition, each of the goal patterns identified compete and often conflict with each other in the midst of a complex healthcare environment (Ebright, et al., 2004). The clear decision about what intervention is best for the patient, or how best to provide an intervention, competes with workflow goals, necessarily. The most experienced RNs manage these situations smoothly and effortlessly (Ebright, et al., 2004).



## **Cognitive Stacking Process**

The third major concept in the proposed framework is cognitive stacking. There is a dynamic and reciprocal relationship between cognitive stacking and clinical reasoning-in-transition. Cognitive stacking is a process defined by the following four characteristics:

1. A cognitive workload management decision-making strategy for dealing with multiple care delivery requirements.
2. A mental list of multiple to-be-done tasks.
3. A failure-sensitive strategy for preventing error and/or minimizing bad outcomes.
4. A discriminator between novice and experienced RN practice (Ebright, et al., 2003).

In addition to RN experience, the effectiveness (breadth, depth, and efficiency) of cognitive stacking and the resulting decisions appeared in the Ebright et al. study (2003), was found to be very dependent on the ability of the RN to maintain situation awareness or on the extent to which the RN could be mindful and make sense of clinical as well as workflow data throughout dynamic situations. As such, cognitive stacking is closely and continuously aligned to clinical reasoning-in-transition, both for its dependence on and informing of clinical reasoning-in-transition work.

Eight different decisions within cognitive stacking have been identified Ebright and colleagues (2009), including four decisions related to where to prioritize an activity on the list (defer, shed, reorder, or complete), and four decisions related to management and control of activities on the list (recruit, cluster, be proactive, or reduce performance

criteria). These workflow management decisions are often found to be important for preventing complications or patient deterioration, and for minimizing apparent problems already in progress (Patterson, et al., 2010). For example, an RN describes deciding to defer care activities that would require continuous attention and availability until team resources are accessible to cover other patients in her assignment. An RN reports making the decision to interrupt current flow of care to complete a task or procedure that is important and, if delayed, might be difficult to fit into the work flow and complexity she or he anticipates for later in the shift. In other words, as a result of anticipation of workflow changes and their potential impact and consequence for clinical aspects of patient care, the RN decides to be proactive to avoid and minimize hazards or chaos later on.

### **Clinical Judgments**

The fourth major concept in the RN CWN framework is clinical judgments. Tanner (2005, p. 205) defined clinical judgment as: “An interpretation or conclusion about a patient’s needs, concerns, or health problems, and/or the decision to take action (or not), use or modify standard approaches, or improvise new ones as deemed appropriate by the patient’s response.”

Tanner’s definition is consistent with Facione and Facione (2008), who proposed that clinical judgments are decisions about what to believe (about a clinical situation) and/or what to do (about a clinical situation). For purposes of the Cognitive Work of Nursing CWN framework, and to more clearly reflect the nature of actual practice bounded by time and setting, Ebright and Sitterding propose a minor modification of Tanner’s definition as follows: The concept of clinical judgments is defined as

interpretations or conclusions about patient needs, concerns, or health problem, and/or the decisions to take actions (or not), use or modify standard approaches, or improvise new ones as deemed appropriate by patient responses and practice field demands.

Clinical judgments result from clinical reasoning-in-transition, and thus in this framework they are the products of problem-solving involving patient needs and concerns, as well as problem-solving surrounding dynamic work complexity contributors and cognitive stacking. Clinical judgments, for the purpose of the proposed framework, incorporate the recommendation to shift from a focus on critical thinking to the multiple ways of thinking proposed by Benner et al. (2009), supporting the belief that critical thinking is necessary, but alone insufficient for nursing practice.

The concepts of the CWN are closely linked; clinical judgments result from clinical reasoning-in-transition complicated by challenges to maintaining situation awareness, application of knowledge in context, and managing competing goals. Though clinical judgments and the appropriateness of these judgments may be inferred by observing a nurse in a given practice situation, interviews are a more effective and robust way to understand the thinking which leads to these judgments, and are a more valid measure of the rationale for decisions.

### **Nursing Practice**

The fifth major concept in the proposed framework is nursing practice. Nursing practice is defined as those activities and interventions implemented by an RN, or delegated to other providers by an RN, as a result of clinical judgments made in the context clinical situations. Nursing practice includes all activities actually performed or delegated by an RN resulting from clinical judgments about what care is needed, when

care is needed, and how to best deliver the care given the demands of the practice field. Examples of nursing practice would include direct-care activities such as vital sign monitoring, dressing changes, assessments, mobilization, pain management, and medication administration.

In addition to those activities and interventions implemented, the RN CPM also takes into account activities and interventions identified as needed in a care situation by standards and guidelines for practice, but not delivered in the actual situation. For example, protocols for pressure ulcer management in an organization may call for routine position adjustment, but the care is not delivered in a situation because the patient is unavailable (a work complexity contributor), workflow overload precludes staff attention to the care needed (requiring cognitive stacking), or there is a care provider performance problem (knowledge-in-context, work complexity contributor)..

### **Patient, Nurse, and System Outcomes**

The sixth major concept in the RN CWN framework is patient, nurse, and system outcomes. Outcomes within the model represent the patient (nurse-sensitive outcomes), the nurse (nursing satisfaction and engagement), and the system (benchmarking system performance in people, safety, quality, innovation, and finance). Mitchell and Shortell (1997), reported in their review of the state of the science that although patient outcomes have shown to be linked to organizational structures in acute care, there was growing evidence that process variables related to nursing surveillance, quality of the working environment, and quality of interaction with other professionals lead to differences among hospitals on mortality and complication rates. These process variables often reflect the actual work of nursing regardless of nursing role or type of organizational

setting. Using a human factors framework, these process variables and their relationships to clinical judgments, nursing practice, and resulting patient, nurse, and system outcomes can be examined to understand the complex and multifaceted aspects of the actual practice of RNs. This examination of processes should include the complex cognitive work of RNs and the effect of the demands of the practice field on RN cognitive work and resulting outcomes, in addition to the organizational structures that best support that work.

Research on nurse-sensitive outcomes has grown over the most recent decade, particularly as the discipline tries to demonstrate nurse impact on patient care. Irvine et al. (1998), developed a model to demonstrate nursing's contribution to patient outcomes based on Donabedian's (1980), structure- and process-outcome model of quality of care called the Nursing Role Effectiveness Model. Structural variables include patient, nurse, and organizational factors; process variables include the independent, medical care-related and interdependent roles of nursing; and outcome variables include nurse-sensitive patient outcomes. Research related to mortality and other adverse outcomes has shown these outcomes to be linked to organizational structures such as staffing and staff mix, rather than process variables (Aiken, et al., 1994; Needleman, et al., 2002)

For purposes of the Cognitive Work of Nursing framework, Ebright and Sitterding propose that outcomes dependent on nursing practice are the result of the cognitive work of nursing. Understanding the concepts and concept relationships represented in the RN CWN will result in enhanced design explaining care-delivery systems and environments to support this cognitive work.

## Chapter Summary

Medication administration error is the eighth leading cause of preventable deaths in the United States. Public demand for patient care safety mandates a concerted effort among providers to understand and mitigate contributing factors; the discipline's efforts to date have been marginal in demonstrated effectiveness (Vogus, et al., 2011). Nursing has authority and accountability for medication preparation and administration, and is therefore culpable for understanding factors contributing medication administration error. Scholarly contributions have influenced the discipline's understanding of medication administration error and the association with interruptions as explained through the cognitive work of nursing. What remains unexplained is the experience of attentional dynamics, such as situation awareness on interruption-handling during medication administration among nurses serving critical care environments within acute care hospital settings.

## CHAPTER III

### METHODS

This chapter describes the research approach and methods used to describe situation awareness (SA) during the medication administration (MA) process and in RN's selection of interruption-handling strategies. The chapter begins with a description of and rationale for the research approach, proceeds to a delineation of the sampling methods and procedures, followed by a discussion of the generation, preparation, management, analysis, processing, and interpretation of data, and concludes with a discussion of ways in which validity will be protected throughout the study.

#### **Research Design: Rational for Approach**

A qualitative descriptive design was used to describe SA during the MA process and the RNs' or participants' selection of interruption-handling strategies. There are six characteristics significant to descriptive qualitative research and consistent with this study design include: 1) the belief in multiple perspectives; 2) a commitment to identifying an approach to understanding that supports the phenomenon of interest; 3) a commitment to the participant's point of view; 4) the conduct of inquiry that limits disruption of the natural context of the phenomena of interest; 5) the acknowledged participation of the researcher in the research process; and 6) the reporting of the data in a literary style rich with participant commentary (Streubert and Carpenter, 2011).

Qualitative descriptive research enabled the researcher to direct her attention to the participant and the participant's real-world experiences rather than to pre-determined, concrete, measurable objectives. The discovery process inherent in qualitative descriptive design allowed the use of various data collection strategies. Commitment to the

participant's point of view, which is characteristic of qualitative descriptive design, was achieved in unstructured interviews. The researcher observed the real-world experience of the study participant. Limiting the use of instruments minimized intrusions and maintained the natural context of the situation under observation, which is characteristic of qualitative descriptive design and was necessary for the proposed study. Moreover, surveys alone are insufficient to understand and describe the cognitive work of nursing. SA and selection of interruption-handling strategies inherent in the cognitive work of the nurse can rarely be reduced to a survey.

The researcher, as an instrument, is yet another characteristic inherent to qualitative design. The qualitative researcher is expected to be true to the participant's expression of the experience and to report findings in a way that illustrates the experience of the people who lived them. Qualitative research reports are rich in narrative and include narrative illustrating the experience observed and phenomena of interest (Streubertand Carpenter, 2011). Designs that give greater emphasis on how the nurse interprets the interruption in the situation of MA, and selects handling strategies based upon that interpretation, will close knowledge gaps not otherwise understood from quantitative design.

In summary, the qualitative descriptive method was selected as the most appropriate for this study for the following reasons: 1) No research has been conducted examining SA during the MA process. 2) No research has been conducted examining SA on the selection of interruptions during the MA process. 3) No research has integrated the combination of interviews, observation, and videography to answer the questions related to the cognitive work of nursing during the MA process. 4) A basic understanding of how



the nurse interprets the interruption is needed. 5) Exploring or examining phenomena about which little is known is best accomplished through qualitative design. 6) The results could inform future qualitative research examining relationships and ultimately could influence quantitative design if deemed necessary to understand the complexity of situation awareness and interruption handling during the medication administration process...

### **Background and Description of Approach**

Cognitive scientists use Cognitive Task Analysis (CTA) to examine SA eliciting information about how a person perceives a situation, comprehends the situation's components, and makes decision or plans based upon the aforementioned comprehension of cues. (Klein, 2006). CTA procedures will be used to describe SA in the selection of interruption-handling strategies during the MA process. CTA is a "family of methods used for studying and describing reasoning and knowledge" (Crandall, et al., 2006 p. 3). Investigators applying CTA methods use the following questions to frame their inquiry: 1) What issue or need does the investigator plan to address? 2) What does the investigator expect to deliver at the end of the project? 3) What sorts of people can tell the investigator about the issue of interest? 4) What aspects of expertise or types of cognition are necessary for the investigator to understand the cognitive work of participants? 5) What types of situations will tell the investigator the most about the issue explored?

CTA examines the cognitive skills necessary to respond to complex situations and to complete tasks. In CTA, tasks are viewed as outcomes individuals are attempting to achieve. Analysis in CTA refers to the scientific examination of component parts and their relationship to the whole. Meaningful CTA is composed of three primary elements:

1) Knowledge elicitation, 2) Data analysis, and 3) Knowledge representation (Crandall, et al., 2006).

### **Knowledge Elicitation**

Interviews, observations, conceptual methods, and process-tracking are examples of methods used to identify what and how people know what they know. Knowledge elicitation methods enable the investigator to discover judgment, strategies, knowledge, and skills that underlie a particular performance or phenomena of interest. The researcher examined the experience of SA in interruption-handling strategies during MA among RNs by using the proposed set of methods of naturalistic observation supported by videography and semi-structured interviews.

### **Interviews**

Interviews are integral to knowledge elicitation methods. Observation alone lacks the narrative that enables a richer understanding of the cognitive work influencing what the researcher observes. Interviews can fill in those gaps and add insights and nuances. The Critical Decision Method (CDM) and Goal-Directed Task Analysis (GDTA) are the preferred interview methods for understanding the requirements of SA that influence the selection of interruption-handling strategies during medication preparation and administration.

### **Knowledge Elicitation: CDM Interviews**

Beyond observation methods alone, it is necessary to understand how a nurse's SA affects nurse decision-making and action, such as the choice to block or allow interruptions during the medication administration process. Klein (2000) emphasizes the need to couple interview technique with observation in determining the link between SA

and task performance. Although much research on SA has examined Level 1 SA (notice), Klein asserts that it is also necessary for researchers to understand how meaning (Level 2) comes into play and influences decision-making. Klein's (2000) position underscores the need to design for real-world situations in context and coupling observation with interviews employing CDM techniques.

CDM is a knowledge elicitation method that enables the investigator to probe an actual situation. CDM enables the discovery of details, challenges, subtle cues, background influences, and strategies that would not otherwise have been discovered in an open-ended interview following controlled simulation. Depending on the sampling plan including experts and non-experts, CDM interviews help the participant tell the story about a particular situation result in the following: cues and patterns of experts and non-experts, rules of thumb devised, kinds of decisions that must be made, features of the situation that make decisions particularly difficult, and features of the situation that make the task typical or rare (Crandall, et al., 2006). This researcher's proposed sampling method reflects the intent to capture data reflecting CTA methods. The CDM procedure rooted in decisions elicits information through four phases or sweeps: 1) Incident or situation identification; 2) Timeline verification; 3) Deepening, and 4) "What if" queries.

The situation proposed for this study is medication preparation and administration occurs in three phases or sweeps. What will be discovered by the RN in the first sweep or initial phase of the conversation are the elements of the situation. It is imperative in the incident or situation to identify the participant's role as doer and decision-maker in the situation. Sweep 1 enables the interviewer to identify cognitive components that will go beyond procedural or task components. Sweep 2 provides the framework to see and

understand the structure and key events. The participant's description of the timeline verification during the interview is critical because it provides a framework for the remainder of the interview. During Sweep 2 of the interview, the interviewer works with the participant to construct a timeline and draw a diagram identifying decision points and or critical junctures where the situation could have been interpreted differently or acted upon differently. A shared view of the facts from the participant's view emerge as the interviewer and participant identify the sequence and duration of events, actions taken, perceptions, thoughts, and decisions.

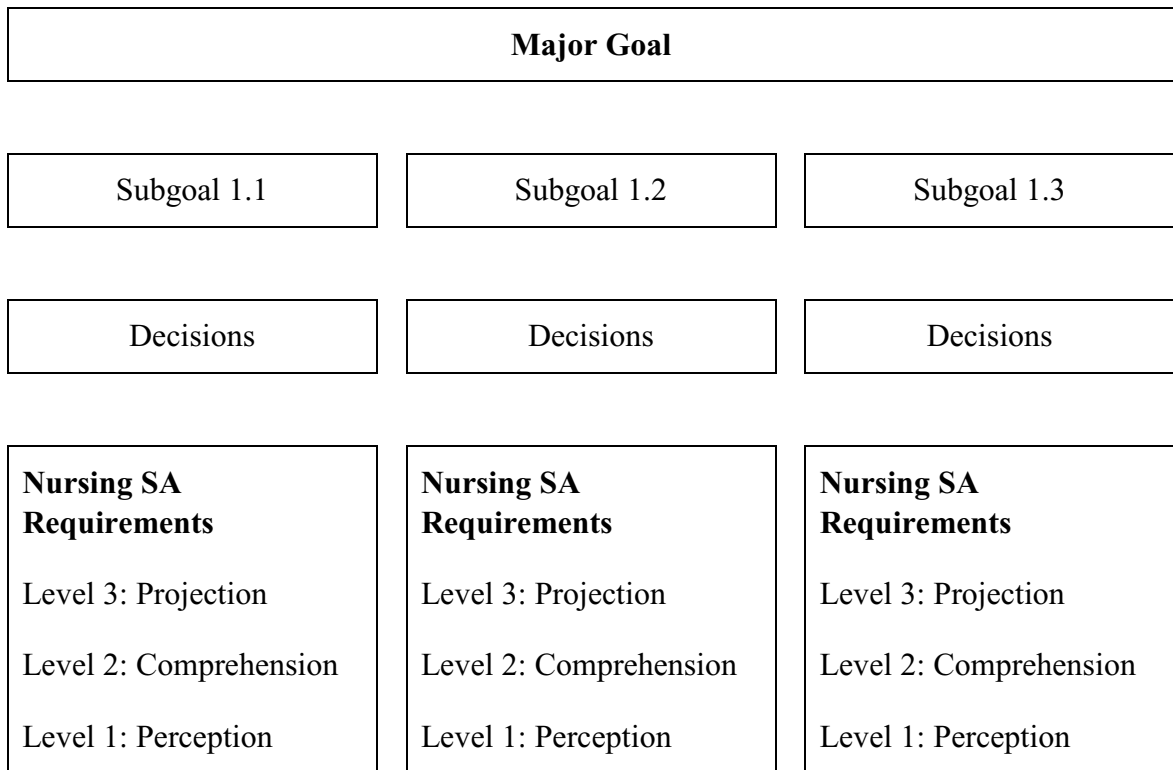
Sweep 3 is moving the participant beyond the basic facts of the situation to deepen the interviewer's understanding of what the participant knew, when he or she gained the knowledge, and what he or she did with what they knew. Sweep 3 of the CDM process employs cognitive probes that uncover the participant's perceptions, expectations, goals, judgments, confusions, and uncertainties about the situation as it unfolded. During Sweep 3, deepening probe questions elicit cues, information, analogs, standard operating procedures, goals and priorities, options, experience, assessment, mental models, decision-making, and guidance (Crandall, et al., 2006). The last phase or Sweep 4 of the CDM identifies enables discovery of participant's skill, knowledge, and expertise.

### **Knowledge Elicitation: Goal-Directed Task Analysis**

The SA experience and the requirements of SA during MA are necessary to understand before interventions can be designed to enhance or improve SA during MA. Endsley (2003) asserts that SA requirements are most effectively delineated through a Goal-Directed Task Analysis (GDTA) interview process. The GDTA process will reveal

what information nurses need to perform safe MA. In this study, the information garnered from this method is depicted in a hierarchy of goals, sub-goals, decisions relevant to each sub-goal and the associated SA requirements depicted in Figure 1 (Endsley, 2003). Limitations of GDTA and other task analysis methods include the subjectivity of the participants (Endsley, M. 2003).

**Figure 1. Goal-Decision-SA Requirement Structure**



Limitations of the CDM and GDTA methods include the availability of expert participants and the lack of capacity to generate the situation. Recruiting for expertise and selecting a situation (such as MA) common to every registered nurse will eliminate these limitations in the proposed study. Additional challenges of the interview method include interviewer skill, time constraints, and the participants' comfort (or lack thereof) divulging details of decisions made and events observed. The aforementioned limitation

will be minimized by investigator alignment with interview guidelines suggested by a human factors experts (Crandall, et al., 2006).

### **Observation**

The unit of observation in this study was the MA cycle completed by RNs. Observation occurred during peak MA hours. The investigator stood at least eight feet from the RN under observation and took field notes while neither interacting with the RN, nor examining patient records. This type of naturalistic observation allowed the investigator to better understand the context of the work, see things that may escape the awareness of the subjects, and discover elements of the process not otherwise noticed (Patton, 2002).

Observation resulted in the following data: 1) case selection for CDM interviews; 2) secondary task triggering the perceived need for interruption selection; and 3) the participant's selection of interruption-handling strategies.

### **Setting**

Data collection took place in an academic healthcare setting in the Midwest of the United States. Two hospital settings were selected and included a large 800-bed teaching facility and an academic hospital.

### **Sampling Methods**

In a qualitative descriptive study, the goal of sampling is to obtain information-rich cases that is, participants who have experience with the phenomenon of interest. Per Sandelowski's (2000a) and Patton's (2001) recommendations for qualitative descriptive sampling techniques, recruitment of respondents should be achieved by purposefully choosing participants who have experience and have knowledge of the phenomenon

(Patton, 2001). According to both Sandelowski (1995b) and Patton (2001), sample sizes in qualitative research cannot be ascertained a priori. Moreover, Sandelowski (1995b) warns against the use of sample sizes that are either too small to plausibly support the notion of informational redundancy or too large to allow for the deep, case-oriented analysis that is the hallmark of qualitative research. The number of participants and hours of observation and interview proposed are consistent with previous studies examining the cognitive work of nursing (Potter, 2003; Ebright, et al. 2004; Colligan, 2012).

Knowledge elicitation data was collected from thirteen nurses until saturation was achieved during the MA process on randomly selected days (Monday, Wednesday, Thursday and Saturday). Purposive sampling resulted in two discrete groups. Group A included registered nurses with three to twenty-four months of practice experience. Group B included registered nurses evaluated by peers and staged as expert and/or proficient nursing practice. Inclusion criteria included: 1) RNs employed within large hospital systems located in the Midwest and designated Magnet; 2) RNs with three to twenty-four months of experience and consistent practice in the nursing unit of observation; and 3) RNs staged as expert by nursing peers with experience and consistent practice in the nursing unit of observation. Exclusion criteria included: 1) RNs in management, supervisory, or nurse education roles with <50% of job responsibilities in direct care; 2) RNs identified as agency, traveler, or contract RNs; 3) RNs identified as new hires or internal transfers employed in the nursing unit of observation less than three months; and 4) RNs within three months of recent leave of absence.

Sampling nurses with greater than five years of experience and staged by their peers as experts and nurses with less than two years is proposed given literature

suggesting differences in decision-making, interruption management, and clinical decision-making (Ebright, et al., 2004; Wickens, et al., 2008; Benner, et al., 2009). Aviation and attention literature provide further support for the sampling strategy to include differences in expertise among nurses (Wickens, et al., 2008). Additionally, the investigator sampled across different types of nursing units (Emergency Department, Intensive Care Unit, Medical-Surgical) to identify common interruptions and SA regardless of the type of nursing unit.

### **Inclusion/Exclusion Criteria**

Inclusion criteria for nurse participants are based upon stages of development and skill acquisition (Benner, P, et al., 1984) and consist of the following: advanced beginners, competent nurses, and expert nurses.

Advanced beginner practice nurses are defined as those with typically less than a year of practice experience who demonstrate marginally acceptable performance and who have coped with enough real situations to generate meaningful situation components. The components require prior experience to be recognized by the advanced beginner. Principles guiding advanced beginner actions are in formation during this stage of skill acquisition.

Competent nurses are defined as those who have been in practice for two to three years. Competent nurses plan their work based upon conscious, abstract, analytical contemplation of the problem at hand. Competent nurses lack the speed and flexibility of the proficient nurse, but have a feeling of mastery and the ability to cope with and manage the many contingencies of clinical nursing. They do not yet have enough



experience to recognize a situation in terms of an overall picture or to discern which aspects are most salient.

Expert nurses do not rely on analytic principles to guide their interpretation of a situation or the action as a result of that interpretation. Expert nurses typically have more than five years of experience, display an intuitive grasp of each situation, and can swiftly identify problems without wasteful consideration of a large range of unfruitful, alternative diagnoses and solutions. Experts operate from a deep understanding of the total situation. They are no longer aware of features and rules; rather, performance is fluid and flexible. This is not to say that expert nurses never use analytic tools. Highly skilled analytic ability is necessary for those nurses to navigate situations with which they have no previous experience (Benner, et al., 1984).

All nurse participants will have had experience with MA. The interruptions encountered by the nurse participants are expected to be varied in nature and familiarity.

### **Assumptions and Potential Limitations**

Assumptions and potential limitations inherent in the sampling plan include the following:

1. The amount of time and experience between the time the nurse participant was staged by the department of education and the time when the nurse participants' expresses interest in the study may influence the accuracy of how the nurse skill acquisition was staged.

2. Years of experience differentiating advanced beginner, competent, and expert nursing practice reflect the literature and department of education staging based upon the literature, but are not quantified by any existing valid or reliable instrument.

<b>Table 3.1: Inclusion and Exclusion Criteria</b>	
<b>Nurse Participant Inclusion Criteria</b>	<b>Nurse Participant Exclusion Criteria</b>
<ul style="list-style-type: none"> <li>• Registered nurses employed by and serving Methodist and University hospitals inpatient, emergency department, or critical care nursing units;</li> <li>• Registered nurses representing the stage of skill acquisition experience between 3 and 24 months of practice; and</li> <li>• Registered nurses representing the expert stage of skill acquisition identified from a pool of registered nurses staged as expert by their peers.</li> </ul>	<ul style="list-style-type: none"> <li>• Student nurses; and</li> <li>• Nurses staged by their peers as experienced-non expert nurses.</li> </ul>

### **Sample Size**

The qualitative approach cautions against the use of sample sizes given qualitative research sample sizes cannot be determined a priori (Sandelowski, 1995). Sampling continued until saturation and or informational redundancy was reached.

### **Recruitment**

Following approval of the study from the Indiana University Purdue University of Indianapolis Institutional Review Board, participants were recruited from Indiana Hospital and Methodist Hospital between November 2012 and March 2013. Recruits were self-referred based upon advertisements in the hospital newsletter, fliers placed in nursing units, and distributed through the shared governance practice meetings at both of the hospitals. Potential participants were screened by the primary investigator based on levels of expertise described in the sampling section. Nurses who expressed interest in participating received a letter of information from the researcher detailing the nature of

the study, study purpose, risks and benefits of participating, and their right to withdraw at any time. If the participant met inclusion criteria and wished to be part of the study, the researcher met with the participant in a private location to obtain informed consent and the following data: academic preparation, certification, practice area, years of registered nurse experience, and skill experience (advanced beginner, competent, or expert). The investigator then arranged a time convenient for the nurse participant to conduct the MA observation and interview. The recruitment process is detailed as follows:

### **Timeline of Recruitment Activities**

November 2012: Sample pool of advanced beginner, competent, and expert nurses provided by Department of Nursing Education

December 2012: Advertisement was disseminated through the hospital system newsletter, nursing unit newsletters, and during the regularly scheduled shared governance councils. Principle investigator contact information was provided enabling recruitment through self-referral.

January - March 2013: Nurses screened for eligibility by the principle investigator based upon inclusion criteria of advanced beginner, competent, and expert nursing practice.

January - March 2013: Nurses interested in participating contacted the principle investigator. Nurses interested in participating received a letter of information detailing the nature of the study, study purpose, risks and benefits, and their right to withdraw at any time.

## **Ethical Considerations**

This study posed minimal risks to nurse participants, all of which are related to the confidentiality of the data. Minimal risk is deemed present when the risks associated with research participation by nurses are no greater than those involved in their everyday practice. Confidentiality for nurse participants was protected through a number of strategies. Nurse participants' names were not recorded. A code number was used to match data consisting of their mother's date of birth and the last three digits of their postal code. This code was replaced by a serial number (double-coding) after data have been matched to further protect nurse participant confidentiality. All hard copy data was stored in a locked file in a locked office in Nursing Quality at Indiana University Health. Any potential identifying information was not removed. Only the researcher who screened participants for inclusion in the study viewed identifiable information of participants. No health information was collected. Any data obtained from nurse participant interviews by the researcher that was shared via publishing was de-identified and anonymous. Only the researcher obtained copies of participants' names and phone numbers, which were stored in a locked cabinet in a private area only accessible to the researcher. For information that was computerized, confidentiality was protected by using passwords and storing any computer-based data in a locked cabinet in a private area only accessible to the researcher. The audio-recordings containing participant interview data were heard, transcribed, and maintained only by the researcher and were kept in a locked cabinet in a private location accessible only to the researcher. No copies of the recordings were made, and the names of subjects were not included in the audio-tapes or transcriptions of the interviews. Risk of participants feeling uncomfortable answering

interview questions or discussing their experiences was addressed by informing nurse participants, as part of the informed consent procedure, and that they may withdraw from the study at any time without consequence. In addition, immediately before the interview, nurse participants were notified that they may abort the interview at any time without consequence, and may choose not to answer any questions that they do not desire to discuss and, if they become uncomfortable while answering or discussing a question, they may choose not to answer or discuss the question without consequence.

Nurse participants were made aware of their right to withdraw at any point in the course of the study. Consent forms specific to the study were provided in English. The study had no direct benefit for nurse participants. At the conclusion of the study, results were shared with the hospitals participating; these results may be useful for quality improvement initiated at both the unit and hospital level. Compensation for participation was not be offered.

The principle of nonmaleficence requires that when an error that can cause harm to a patient is observed, the observer has the ethical obligation to stop it (Diaz-Navarraz, et al., 2006). The beginning and ending boundaries for observation for this study did not include patient observation and or nurse-patient interaction. The determination of a medication adverse event is not the objective of this study and will not be made in the course of observation or analysis.

### **Data Generation: Instrumentation**

Demographics include the hospital, type of nursing unit, years of RN experience on nursing unit observed, whether the RN had been staged as expert, academic preparation, specialty certification, shift, duration and time of observation.

Interruptions, selection of interruption-handling strategies, and nurse workload tasks were gathered. The objective of observations and in situ interviews for CTA is to capture the authentic behavior of the worker – in this case, the nurse. The observations were expected to be two-to-three hours in duration with the aim of case selection for the interview process. The researcher observed authentic interruption-handling behavior given that the researcher, who is also a nurse, had been accepted into the culture of work. Acceptance in the case of the participant and the principle investigator suggests the workers (nurses) regard the observer as informed, sincere, and intent toward helping through the study experience (Crandall, et al., 2006).

Selection of interruption-handling strategies was verified during the interview by the aforementioned cognitive task analysis in combination with observation.

Semi-structured interviews were conducted within one week of the observation and were expected to be sixty to ninety minutes. Interviews as described previously were conducted and reflected CDM and GDTA methods to determine the cognitive work of the nurse and selection of interruption-handling strategies. The goal of data generation in a qualitative descriptive study is to generate information regarding participants' experiences with the phenomenon, especially surrounding the specific research questions guiding the study, in their own words. Sandelowski (2000a) suggests that the most appropriate means for achieving this goal is via the use of minimally to moderately structured interviews. Face-to-face, semi-structured interviews in contrast to the more commonly used MA and work flow surveys previously discussed were the means by which data was generated in this study.

Semi-structured interviewing is characterized by the use of pre-planned interview questions and probes. When using any of these interview techniques, all questions asked are open-ended (Patton, 2001). Semi-structured interview questions developed based on the research questions guiding the study. Table 3.2 contains examples of semi-structured interview questions that were used, including a rationale for the inclusion of each question. These questions served as the initial means of generating data during interviews. All questions were open-ended to allow participants to fully describe the experience of situation awareness on selection of interruption-handling strategies during MA.

<b>Table 3.2: Situation Awareness in Nursing: Probe Topics and Semi-Structured Examples of Questions</b>	
<b>Examples of Probing Questions: Guided Interview</b>	<b>Rationale and Listening for Answers</b>
<p>Cues/Knowledge</p> <ul style="list-style-type: none"> <li>• What were you hearing, seeing, and noticing?</li> <li>• What was it about the interruption that let you know what was going to happen?</li> <li>• How did you get that information? What did you decide to do with that information? What knowledge was necessary for you or helpful in the situation? What you reminded of any previous experience? What about that previous experience seemed relevant in this case?</li> </ul>	<p>SA Level 1:</p> <ul style="list-style-type: none"> <li>• Perception of interruption specific to clinical cues relevant to the patient and his or her environment;</li> <li>• Perception of the situation and the severity or complexity of the interruption; cues and their implications.</li> </ul>
<p>Expectations</p> <ul style="list-style-type: none"> <li>• What were your expectations at this time?</li> </ul>	<p>SA Level 2:</p> <ul style="list-style-type: none"> <li>• Comprehension and assignment of meaning to those cues specific to the interruption resulting in a patient-centric sense of salience.</li> </ul>

<p>Goals</p> <ul style="list-style-type: none"> <li>• What were your specific goals and objectives at this time? What was most important to accomplish at this point in the process?</li> </ul>	<p>SA Level 3:</p> <ul style="list-style-type: none"> <li>• Projection and/or anticipation of required interventions based on those meaning assigned from interruption cues.</li> </ul>
<p>Decision Point</p> <ul style="list-style-type: none"> <li>• What interruption-handling decision did you make in this situation? What other courses of action were available to you? How was this particular decision made or others was rejected? How much pressure was involved in making this decision? How long did it take to actually make this decision? What training or experience was helpful in making this decision? Might a nurse with different experience, what type of error might she or he have made and why?</li> </ul>	

### **Data Preparation, Management, and Analysis**

Activities to accomplish cognitive task analysis were approached in four phases: preparation, data structuring, discovering meaning, and representing qualitative description.

#### **Preparation**

The objective of the preparation phase is to evaluate the completeness and accuracy of the data set. This phase included a complete review and inclusion of interview data, observational data, and instrument data. Preparation required that all participant files be consistent and clearly labeled including participant code, interviewer, type of data, and date of data collection. Audio and videotapes were catalogued and reviewed. Transcripts were prepared and reviewed for accuracy. The research team read



all the data records, wrote down any questions and thoughts, and reconvened for an initial assessment of the data. The process of preparation of cognitive task data is that the team will move from an informal, intuitive sense of the data to a structured and systematic analysis process as described by Crandall, et al. (2006 p. 113).

### **Structuring the Data**

The goal of the data structuring phase is to examine the data as a collection of discrete elements and to gain some sense of where there may be useful connections within the data (Crandall, et al., 2006). Individual data records and interviews informed content analysis during the data-structuring phase of analysis. Reviewing the data with a cognitive focus mindfully considering situation awareness and interruption-handling strategies provided an initial orientation to structuring the data. Observations were informed by the following questions:

- Where is the nurse's attention?
- What is he/she paying attention to and what is he/she ignoring?
- What senses are they using?
- What are they looking at, listening for, touching, smelling?
- What are they thinking about?
- What are they wondering about, what are they worried about, what are they certain about?
- What information are they seeking, and from what source?

Data structuring required the researcher to work through the entire data set systematically and note content pertaining to the process of medication administration, situation awareness, interruption-handling, and task-switching. The systematic approach

to data structuring can be accomplished through classifying or cataloging specific content, making lists, sorting data elements into categories, identifying and marking off critical intervals, or counting the instances of occurrence of various factors (Crandall, et al. 2006 p. 114).

### **Discovering Meaning**

The objective of this phase of the analysis is to identify the significant findings contained in the data. Identifying the significant findings emerges as a result of a systematic examination of the concepts and relationships noticed in both the individual interviews and subsets of the data across the larger data set as a collective whole. The systematic examination was accomplished through the following activities:

#### **Integration and synthesis of data elements**

Description of regularities in the data by identifying patterns, themes, and cue sets including the identification of inventories for critical cues.

Examination of group similarities and differences, for example contrasting the expert and advanced beginner nurses and or work settings comparing the medical-surgical environment to the critical care nursing work environment.

#### **Identifying and Representing Key Findings**

Representing key findings took the form of narrative format, chronologies, data organizers, process diagrams, and/or concept maps. Narrative formats reveal the richness of the lived experience and how that particular event was managed. Chronologies illustrate the representation of how the situation in context can change and how time impacts the cognitive aspects of performance. Chronologies are beneficial in providing multiples views and illustrating the complexities of tasks and events observed. Data

organizers are used to synthesize data combining data from multiple data sets into one common format highlighting for example cognitive requirements such as decision challenges, cues and information, strategies, and novice traps (Crandall, et al., 2006). Process maps are helpful in illustrating cognition in action. Concept maps are graphical depictions of the knowledge for a particular task or work domain. The intent of this investigation was to examine the data from multiple perspectives so that the phases of analysis are complete, accurate, and consistent with the research questions to examine SA in selection of interruption-handling strategies among nurses during medication administration.

### **Chapter Summary**

Because very little is known about SA in the selection of interruption-handling strategies and task-switching among registered nurses during MA, a qualitative descriptive approach was most suitable to investigate this phenomenon. Observation has been successfully used to determine factors influencing the complexity of the nursing work environment, tasks, and interruptions. However, observation alone is insufficient to explore and understand cognitive requirements informing the selection of interruption-handling strategies observed. Therefore, CTA methods such as CDM and GDTA are appropriately selected to determine the requirements of SA necessary to manage interruptions in a highly complex nursing work environment.

Purposive sampling was employed to recruit nurses serving a variety of practice settings with a variety of nursing expertise to determine common elements specific to the cognitive work of MA. Semi-structured interviews were conducted within one week of observations of RNs on nursing units during the medication administration process. Data

was generated via face-to-face interviews and analyzed via cognitive task analysis methods described. The final interpretation is presented in a manner that answers the research questions and remains faithful to the data. Findings rendered from this study provide the necessary basic understanding of the experience of situation awareness in the selection of interruption handling strategies among registered nurses during medication administration.

## CHAPTER IV

### FINDINGS

This chapter includes study findings, a descriptive review of the sample, the principle themes that emerged as a result of observations, videography, and interviews with direct care nurses serving the medical surgical and critical care environments within two Magnet-designated adult hospitals. Exemplars representing the themes illustrating the description of situation awareness and levels of situation awareness, interruption handling, and the cognitive work of nursing during the medication administration process are provided throughout the chapter.

#### **Sample Characteristics**

The study included thirteen direct care nurses, who were categorized into two groups: those who have worked twenty-four months or less and those who were evaluated and staged by peers as proficient and or expert in nursing care delivery. Table 4.1 illustrates sample characteristics including gender, academic preparation, years of experience or staged expertise, number of interruptions during medication administration, video and observation time, interview time, frequency of interruption handling strategies, and practice area. The average observation and videography time/registered nurse was 92 minutes (1.5 hours). Total videography and observation time was 20 hours coupled with 16 hours of interviews. Two-hundred, thirty interruptions were observed and described. Critical care and medical surgical nursing environments were evenly distributed. Ninety-two percent of participants were BSN-prepared and the same percentages were female in gender.

<b>Table 4.1: Participant Demographics, Interruptions, and Video and Interview Time</b>				
<b>Gender and academic preparation</b>	<b>Experience/ Expertise</b>	<b>Number of Interruptions During MA</b>	<b>Total Video Time Including MA Time Interview Time (all times in minutes)</b>	<b>Practice Area</b>
F/BSN	Staged Expert	<5 (Her role documenting a code situation.)	92 55	CC-ED Primarily
F/BSN	Staged Expert	<5 (Very low census and she had only 1 patient.)	100 60	M-S Primarily Described
F/ASN	< 24 months	15	65 75	M-S
F/BSN	Staged Expert	25	95 75	CC
F/BSN	< 24 months	20	98 60	CC
F/BSN	Staged Expert	8	90 90	CC
F/BSN	30 months	27	92 70	M-S
F/BSN	< 24 months	34	95 60	CC
M/BSN	< 24 months	48	100 90	M-S
F/BSN	Staged Expert	8	98 90	M-S
F/BSN	Staged Expert	13	90 75	M-S
F/BSN	< 24 months	16	90 75	M-S
F/BSN	< 24 months	<5 (Very low census and she had only 1 patient.)	95 60	M-S

As discussed in Chapter III, the final interpretation of data in qualitative descriptive research is best illustrated in the form of emergent themes, a theme is defined as “an abstract entity that brings meaning and identity to a recurrent experience and its variant manifestations. As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole” (DeSantis & Ugarriza, 2000, p. 362.). Themes have form through patterns and function to unite or unify and illustrate the meaning or essence of an experience. Themes (and sub-themes) are described and organized by level of situation awareness initially in this chapter followed by a description of additional themes representing the cognitive work of nursing during the medication administration process.

During the interviews, participants viewed the videotape and through cognitive task analysis probes, the participants described their recall of that particular shift, their particular work setting, their particular patients, and relationships among their co-workers. Participants identified interruptions during the review of videography and observed by the researcher. Participants described and defined interruptions as breaks in their task. Additionally, participants described the nature of the stimuli noticed and their response to the nature of stimuli noticed during the medication administration process. The critical decision method was used to elicit situation specific cues revealing the nature of the stimuli noticed, meaning assigned to the nature of stimuli noticed, and projection or anticipated task and care requirements informed by the nature and meaning of stimuli noticed. The aim of the research was to describe situation awareness and the selection of interruption handling strategies during medication administration. Directed content analysis revealed theme phrases describing situation awareness and the selection of interruption handling strategies during the medication administration process. The three

major theme phrases include: perception (SA1) the nature of stimuli noticed; comprehension (SA2) or the meaning of the stimuli noticed; and projection of needs (SA3) or workflow during medication administration.

<b>Table 4.2: Emergent Themes Reflecting SA during the MA Process</b>		
<b>SA1 Theme Phrase: Nature of stimuli noticed.</b>	<b>SA2 Theme Phrase: Meaning assigned to stimuli noticed.</b>	<b>SA3 Theme Phrase: Projected or anticipated workflow priority.</b>
Definition: dynamic process where the nurse perceives visual, auditory, or interrupting thought stimuli relevant to the patient or environment	Definition: comprehension and assigned relevance, uncertainty, or expectations to the nature of stimuli noticed influencing nurse interpretation of stimuli salience	Definition: projected or anticipated workflow priorities as a result of assigned meaning to the nature of stimuli noticed
<ul style="list-style-type: none"> <li>• Visual (patients, family, team, equipment)</li> <li>• Auditory (people, phones, alarm, intercom)</li> <li>• Interrupting Thought</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainty</li> <li>• Relevance</li> <li>• Expectations</li> </ul>	<ul style="list-style-type: none"> <li>• Patient-centric</li> <li>• Team-centric</li> </ul>

### **SA1: Nature of Stimuli Noticed**

The major theme phrase that emerged regarding the description of SA1 and the selection of interruption handling strategies during medication administration was the nature of the stimuli noticed defined as a dynamic process where the nurse perceives visual, auditory, or interrupting thought stimuli relevant to the patient or environment. Minor themes illustrating the nature of the stimuli noticed included visual, auditory, and interrupting thought stimuli or cues. Categories of visual, auditory, and interrupting thought cues or stimuli are described and demonstrated.



### **SA1: Nature of Stimuli Noticed: Visual**

Direct care nurse perception of clinical cues relevant to the patient and his or her environment was discovered during the interview process. Visual stimuli identified by participants included people and equipment. Types of visual stimuli representing people and equipment included the types of people, such as the patient, patient's families, and the care delivery team. Categories of visual stimuli representing equipment included medication delivery pumps, call lights, and supplies. Categories of visual stimuli representing people include: patients, family members of patients, care delivery team members (other nurses, physicians, therapists, non-licensed team members). Table 4.3 demonstrates exemplars representing the description of SA as the nature of visual stimuli noticed.

### **SA1: Nature of Stimuli Noticed: Auditory**

Direct care nurse perception of clinical cues relevant to the patient and his or her environment and illustrated in the nature of auditory stimuli noticed was evident in observations and revealed during the interview process during participant videography review and recall of auditory stimuli noticed during the medication administration process. Data interpretation further revealed that the nature of the auditory stimuli triggered not only auditory attention but also visual attention. Patterns revealing categories of auditory stimuli included: people, phones, the intercom, and alarms. Table 4.3 demonstrates exemplars representing the description of SA as the nature of auditory stimuli noticed.

### **SA1: Nature of Stimuli Noticed: Interrupting Thought Cue**

The nature of stimuli noticed was additionally revealed through otherwise invisible nurse work or cognitive processes that emerged as interrupting thought cues; that is, a dynamic process where the nurse perceives interrupting thought stimuli relevant to the patient or environment. Situation awareness depends on one's capacity to constantly manage competing sources of information and differentiating between unnecessary information and only information that is relevant to the particular task at hand (Endsley, 2003). Interrupting thought stimuli or cues seemed to be the result of recall pertinent to knowledge of what was happening around the nurse, their patient, and within their environment. Described during the interview was the development of an interrupting thought influenced by a particular knowing or relevance of knowledge the nurse brought to that particular situation. Interestingly, interrupting thought stimuli or cues were illustrated in all participants; however the direct care nurses with less than twenty-four months experience interrupting thought cues seemed fewer in number and were without explanation of origin. That is, the less experienced nurses were unable to explain the origin or rationale for the interrupting thought, even though they acted upon it. Moreover, regarding of nurse experience, interrupting thought cues were closely aligned with concern for either the patient and/or team members demonstrating a propensity of concern for patient safety in the midst of nursing work.

**Table 4.3: SA 1 Nature of Stimuli Noticed**

<p><b>SA Level 1 Nature of Stimuli Noticed: Dynamic process where the nurse perceives <i>visual</i> stimuli relevant to the patient or environment.</b></p>	<p><b>SA Level 1 Nature of Stimuli Noticed: Dynamic process where the nurse perceives <i>auditory</i> stimuli relevant to the patient or environment</b></p>	<p><b>SA Level 1 Nature of Stimuli Noticed: Dynamic process where the nurse perceives <i>interrupting thought</i> stimuli relevant to the patient or environment.</b></p>
<p>"The olive scrubs was the respiratory therapist." (&lt;24 months)</p>	<p>"I heard a voice. I noticed someone was in his room." (staged expert)</p>	<p>"Just remembered — noticed they were all meds." (Response to noticing the meds were all oral and what that information meant for the future ... for her patient that was near non-responsive; staged expert)</p>
<p>"I saw the husband." (other patient; &lt;24 months)</p>	<p>"I heard the phone." (&lt;24 months)</p>	<p>"I just remember hearing he put in an order for potassium." (staged expert)</p>
<p>"I recognized that that was the ENT team ... I saw them walking down the hall, we don't have a whole lot of ENT patients ... I happened to see one of them was holding a trach box in their hand." (staged expert)</p>	<p>"I heard an IV pump." (staged expert)</p>	<p>"I honestly don't know. I just remember I think it's just one of those things in the morning ..." (Her response to simply stopping herself in the middle of the hallway between the medication room and her other patient's room; &lt;24 months)</p>

## **SA2: Meaning Assigned to the Nature of Stimuli Noticed**

The major theme phrase that emerged describing situation awareness level two among nurses during the medication administration process and the selection of interruption handling strategies was the meaning assigned to the nature of the stimuli noticed. The data illustrates the interactive nature between SA levels; that is the interdependent relationship between the nature of the stimuli noticed and the nurse assignment of meaning to the nature of stimuli noticed. Patterns of thought reflecting nurse assignment of meaning to the nature of stimuli noticed and illustrated in the data resulted in the following assigned meaning sub-themes: relevance, uncertainty, and expectations themes in response to the nature of stimuli noticed.

### **SA2: Meaning Assigned to the Nature of Stimuli Noticed: Relevance**

Assigned meaning to the nature of visual, auditory, or interrupting thought stimuli noticed reflected cognitive work resulting in assigned relevance to stimuli noticed. Patterns of assigned meaning reflecting relevance were revealed more often among nurse at or greater than 24 months experience. Relevance was revealed as an assigned response and meaning to the nature of the stimuli noticed when what was happening within the situation at hand did not meet the direct care nurse expected clinical goals and nursing work at the time. In the example illustrated in Table 4.4, the nurse was in the midst of traveling from the medication administration room to one of her patient's rooms when she saw the respiratory therapist (SA1 – visual stimuli) caring for another one of her patients ask her about one of her patient's oxygen settings. The nurse in the example chose to engage (interruption handling) given her assigned relevance (SA 2) to the stimuli noticed and concern for her patient's respiratory status. The cognitive work

among nurses caring for other patients in the midst of the medication administration was discovered throughout the investigation of the nurse in the midst of medication and will be expanded upon later in the chapter.

**SA2: Meaning Assigned to the Nature of Stimuli Noticed: Uncertainty**

Assigned meaning to the nature of visual, auditory, or interrupting thought stimuli noticed (SA 1) reflected cognitive work resulting in assigned uncertainty (SA 2) to stimuli noticed. Data analysis resulted in patterns reflecting a direct care nurse state or feeling where he or she did not know or understand something about the nature of what was noticed, but felt a need to know. Additionally, patterns of data shaping the form of uncertainty illustrated that the information unknown was of particular import, that is nurse concern that critical data – critical knowing and relevant to the patient was missing. The example illustrated in Table 4.4 illustrates the cognitive work of the nurse assigning uncertainty (SA 2) in response to noticing a team of physicians walking down the hall and one of the physicians carrying a tracheostomy kit.

**SA2: Meaning Assigned to the Nature of Stimuli Noticed: Expectations**

Performance expectations and perceived consequences were revealed as nurses assigned meaning to visual and auditory stimuli noticed. Expectations in the form of data were revealed as nurses described performance requirements and specifically the timeliness of their response to auditory stimuli noticed such as the phone, call lights, intercoms and or to patients, families, other team members. The example illustrated in Table 4.4 illustrates the cognitive work of the nurse assigning expectations (SA 2) in response to noticing a patient and family in the hall as she is on her way to another patient's room to administer medications.

<b>Table 4.4: Nature of Stimuli Noticed (SA1) and Assigned Meaning Themes (SA2)</b>	
<b>SA 1: Dynamic process where the nurse perceives (visual) stimuli relevant to the patient or environment</b>	<b>SA 2: Comprehension and assigned relevance, uncertainty, or expectations to the nature of stimuli noticed influencing nurse interpretation of stimuli noticed.</b>
"The olive scrubs was the respiratory therapist." (<24 months)	"My (other) patient in 15 was on a venti mask. She had gotten up to use the restroom and when she got up she had de-satted, she had bumped her up to 100% which was overkill." (Relevance)
"I recognized that that was the ENT team ... I saw them walking down the hall, we don't have a whole lot of ENT patients ... I happened to see one of them was holding a trach box in their hand." (staged expert)	"I was like, you know, hey are you changing out his (other patient) trach, are you downsizing him, like what's going on? Downsizing his trach could be very uncomfortable for the patient ... painful ... when they downsize a trach ... best described as you breathe through a bigger straw and then all of a sudden they give you a little straw and try and breathe through it!" (Uncertainty)
"I saw the husband (other patient)." (<24 months)	"Pretty simple – was it okay if he walked her in the hallway. We get a lot of that ... if the patient or family member sees us in the hallway, I guess they believe it's fair game for them to stop us, even if they see our hands are full." (Expectations)

### **SA3: Projected or Anticipated Workflow Priority**

Sub-themes that emerged and reflect the cognitive work of the nurse projecting or anticipating workflow priorities in the midst of the medication administration process include: team and task-centric and patient-centric foregrounds. The term foreground is

proposed as all participated demonstrated great concern for their patients though projecting or anticipating workflow patterns revealed task/team and patient-centric workflow priorities. Data analysis continued to reveal the interactive and interdependent relationship between the levels of situation awareness. Of import is to note SA3 projected or anticipated workflow prioritization is in response to assigned meaning of relevance, uncertainty, or expectations in response to the visual, auditory, or interrupting thought stimuli noticed (Table 4.5). Strikingly, among all direct-care nurse participants was the priority of attention to workflow.

<b>Table 4.5: Stimuli Noticed (SA1), Meaning Assigned (SA2), Anticipated/Projected Needs (SA3)</b>			
<b>Experience Level</b>	<b>SA 1: Dynamic process where the nurse perceives (visual, auditory, or interrupting thought) stimuli relevant to the patient or environment.</b>	<b>SA 2: Comprehension and assigned relevance, uncertainty, or expectations to the nature of stimuli noticed influencing nurse interpretation of stimuli noticed.</b>	<b>SA3: Projected or anticipated patient or team and task-centric workflow priorities as a result of assigned meaning to the nature of stimuli noticed.</b>
<24 months	"I was pulling meds and phone rang. I just did both at the same time." Theme: <b>Auditory.</b>	"It's expected. You never know who it is or what they need." Theme: <b>Expectations.</b>	"I've got three people behind me I'm going to try to hurry up for them." Theme: <b>Team-Centric Workflow.</b>
Staged Expert	"I heard the alarm." Theme: <b>Auditory.</b>	"I knew it was my line." Theme: <b>Relevance.</b>	"I just asked, 'Can you go in there real quickly and add some volume?' That way I would, you know, know the patient is still getting the medication that they need." Theme: <b>Patient-Centric Workflow.</b>
Staged Expert	"I just remember hearing he put in an order for potassium." Theme: <b>Interrupting Thought.</b>	"I thought I don't really remember this patient's potassium." Theme: <b>Uncertainty.</b>	"... pulled his labs back up too much potassium in their system – heart could stop and that's huge. Saw that he actually hadn't had labs drawn in three days, so, and that's when I called the doctor and I said, 'So what are you basing this 40 of K on?'" Theme: <b>Patient-Centric Workflow</b>



## **Situation Awareness and Interruption Handling Strategies during Medication**

### **Administration**

A second aim was to describe situation awareness and the selection of the interruption handling strategies during the medication administration process among direct care nurses serving adult acute medical-surgical and critical care environments. Thirty-six hours of videography, observation, and interviews were conducted informing an analysis of 230 interruptions and interruption handling strategies during the medication administration process. Twenty-hours of videography and observation were completed with an average of ninety-two minutes of observation and videography per direct care nurse. As described in the previous chapter, interviews were scheduled and conducted within seven days of the videography and observation sessions.

Emergent themes describing situation awareness in the selection of interruption handling strategies during medication administration were consistent with emergent themes related to all three levels of situation awareness during medication administration prior to the interruption. Interestingly, the most frequently selected interruption handling strategy direct care nurses selected was to engage, that is the nurse assessed the interruption to be a high priority therefore suspending the primary task (medication administration) so that the higher priority secondary task (interruption) could be engaged immediately. The primary task of medication administration was later resumed. Among interruptions observed, videotaped, and analyzed, 60% (130/215) were handled immediately through engagement. However, 18% (40/215) of the interruptions were blocked, as administering medication took priority as the primary task, while the interruption was perceived as a secondary task. Nurses multi-tasked medication

administration while also responding to the interruption 12% (26/215) of the time observed and confirmed during the interview. The least likely interruption handling strategy to be chosen was mediation; that is, the interruption was identified as a high-priority task, so the direct care nurse deflects the secondary task to another team member. Data reflecting thematic analysis regarding the description of SA in the selection of interruption handling strategies during medication administration is illustrated in Table 4.6.

<b>Table 4.6: Situation Awareness and Interruption Handling during the Medication Administration Process</b>			
<b>Interruption Handling Strategy/Experience</b>	<b>SA 1: Dynamic process where the nurse perceives (visual, auditory, or interrupting thought) stimuli relevant to the patient or environment.</b>	<b>SA 2: Comprehension and assigned relevance, uncertainty, or expectations to the nature of stimuli noticed influencing nurse interpretation of stimuli noticed.</b>	<b>SA3: Projected or anticipated patient or team and task-centric workflow priorities as a result of assigned meaning to the nature of stimuli noticed.</b>
Block: Staged Expert	"Saw the nurse, I glanced at it (blood sugar report) when he gave it to me." Theme: <b>Visual.</b>	"It was fine. Fine meant ... within the parameters that I knew." Theme: <b>Relevance.</b>	"I wasn't going to have to cover that patient at that moment." Theme: <b>Patient-Centric Workflow.</b>
Engage: Staged Expert	"Resident came in during med pass and said he was just going to do staple removal. I had to see. Any time somebody comes into a patient room, you	"I knew it might go more in depth than just an actual staple removal itself ... knowing that it was a surgical intern, they are knowledgeable, but sometimes they only	"They don't necessarily think about the supplies they need, about the patient, you know the patient, the pain medication, whatever. Interns go in, open up wounds,

	want to be there because you just never know." Theme: <b>Visual</b> .	focus on the task at hand, kind of like a new nurse." Theme: <b>Uncertainty</b> .	and leave it open ... you really want to assess the wound." Theme: <b>Patient-Centric Workflow</b> .
Multi-task: <24 months	"I was pulling meds and phone rang. I just did both at the same time." Theme: <b>Auditory</b> .	"It's expected. You never know who it is or what they need." Theme: <b>Expectations</b> .	"I've got three people behind me I'm going to try to hurry up for them." Theme: <b>Team-Centric Workflow</b> .
Mediate: Staged Expert	"I heard the pump alarm. I knew it was his amniodarone drip. I could see he wasn't anxious, he was resting. He was calm. The only thing abnormal was the beeping." Theme: <b>Auditory</b> .	"I knew that nurse that had said something to me is extremely competent. The patient was fine. I'm looking at his heart rate and he's not in a fib currently. His heart rate is fine and his blood pressure is normal." Theme: <b>Relevance</b> .	"I would need to put on an isolation gown and gloves ... it's just extra steps that are unnecessary ... so am I needed right this second? All those factors were enough for me to know the other nurse could handle." Theme: <b>Patient-Centric Workflow</b> .

### **Additional Themes Describing Nursing Work and the Medication Administration**

#### **Process**

Cognitive time-sharing, saturated knowing, and RN judgment were additional themes illustrating the cognitive work of the nursing in the midst of the medication administration process and revealed through observation, videography, and interviews.

## **Cognitive Time Sharing, Interruption Handling During and Medication**

### **Administration**

For the purposes of this study, cognitive time-sharing is defined as divided attention without measure and ranging from perfect time sharing to cognitive overload influencing attentional or change blindness among direct care nurses during the medication administration process. One hundred percent of participants observed, videotaped, and interviewed described and demonstrated engagement in cognitive work for patients other than for those for whom they were administering medications during the time of medication administration. Though cognitive time-sharing was evident among all participants illustrating the association between interruptions and cognitive nurse work during the medication administration process, the demonstrated link between cognitive time-sharing, interruptions, medication administration, and patient safety in terms of error was not revealed and remains unknown. In contrast, interruption handling and cognitive time-sharing revealed in this study illustrated that interruptions can contribute to the safety of patient care (Table 4.6).

### **Saturated Knowing, Interruption Handling during the Medication Administration**

#### **Process**

Another emergent theme that seemed to influence the nurse assignment of meaning to stimuli noticed was what we referred to as saturated knowing. For the purposes of this study, saturated knowing is defined as the culmination of subtle cues influencing macro level of perception, comprehension, and projection – sense-making the invisible to a lesser experienced nurse. One example of saturated knowing is reflected in an expert critical care nurse as she noticed visual and auditory stimuli triggering her

assignment of meaning reflecting saturated knowing that resulted in her projection or anticipation of patient needs. The expert nurse describes as follows:

I was standing right across from the room so I could visually look and see that my patient was not anxious, upset, they were resting. I'd already gotten report and I already knew what drips they were on. If it had it been a pressor, I would have been garbing up and going in there. I would have known that when the pump beeped the patient's not receiving the medication that they need and it could very quickly have a detrimental effect on their vital signs. The nurse that came in...I would trust her to take care of me. I trust her judgment and I mean I trust her sense of knowing whether there is something urgent. I think all of those factors were enough for me to know that even if the beeping was still continuing or if she had addressed it, it was all going to be fine, you know, for the duration of a minute, maybe two minutes longer that it was going to take me to get into the room.

### **RN Judgment, Interruption Handling during the Medication Administration**

#### **Process**

RN Judgment also emerged as a theme that seemed to influence the nurse assignment of meaning to visual, auditory, or interrupting thought stimuli noticed. Depending on the assigned relevance, uncertainty, or expectations meaning assigned to stimuli noticed, the RN was on occasion noted to make judgment about whether to act consistent with the cognitive work of projecting or anticipating workflow. For the purposes of this study, RN judgment is defined as conclusions about patient needs and the RN decision to act (or not). Examples illustrating RN judgment reflect one nurse with less than 24 months experience who described her response to noticing auditory stimuli interpreted as a ventilator alarm and her response to the ventilator alarm:

I heard the vent alarm. I stop meds pass for the vent alarm and for the dialysis alarm.

In another example of RN judgment, a critical care nurse in the midst of medication administration describes cognitive problem solving in response to an otherwise other patient's intravenous pump alarm as follows:

I'm in the middle of meds pass and I think through do they look like they can handle another 5 minutes? I can do meds in 5 -10 min. Do they need lytes? Is their K 3.4 or 2.8? 3.4 can wait.

### **Situation Awareness and Nursing Expertise**

Cognitive work attempting to detect visual and or auditory stimuli through scanning and interrupting thought stimuli were noted to be more prevalent among expert nurses. Both groups of nurses (expert and less experienced) responded to visual stimuli – people and equipment – however, in addition to noticing and assignment meaning to visual stimuli and cues presented to them, expert nurses, in contrast to nurses with less than 24 months experience, constantly scanned areas and looked in patient rooms, as if to detect visual or auditory stimuli even if they were not responsible for those patients. Noticing interrupting thought stimuli or cues were illustrated in all participants; however the direct care nurses with less than twenty-four months experience were without explanation of origin for the interrupting thought. That is, the less experienced nurses were unable to explain the origin or rationale for the interrupting thought, even though they acted upon it. Remarkably, both groups of participants reflected cognitive work or cognitive time-sharing that is, clinical problem solving and decision making about patients other than those for whom current medication administration was occurring.

Relevance, uncertainty, and expectations as an assignment of meaning to the nature of visual, interrupting thought, or auditory stimuli noticed did not seem to be different between the two groups of nurses participating. Interestingly, the phone was the

only stimuli that triggered almost immediate engagement (that is, answering the phone) of medicine delivery for all nurses. Nurses' actions in both groups were patient-centric, yet workflow was a major priority for direct care nurses. During the administration of medication, they also were cognizant of the needs of the medical team and the needs of the patients.

### **Chapter Summary**

To summarize, during the study period, thirteen direct-care nurses were observed and videotaped before and during the administration of medication process. Directional cognitive task analysis techniques such as CDM and GDTA enabled the discovery and description of SA before and in the selection of IHS during medication administration. The expert nurses responded not only to the auditory and visual stimulation, but they constantly were scanning areas, while the less experienced nurses responded almost entirely to the visual cues presented in front of them. Despite the interruption, situation awareness could be described at each of the three levels of situation awareness and informed by the nurse noticing visual, auditory, or interrupting thought stimuli, assigning relevance, uncertainty, or expectations to the stimuli noticed, and projecting or anticipating patient or team and task-centric workflow implications. Striking was the finding that 81% of interruptions were accepted, that is permitted during the medication administration process with mediation as the least likely interruption handling strategy selected. Workload prioritization was evident among all participants with workload foregrounds alternating between patient and team priorities. All participants engaged in cognitive time-sharing problem solving and decision-making about other patients than for those to whom they were in the midst of the medication administration process. The

association between cognitive time-sharing, interruptions, interruption handling during the medication administration process, and error was not revealed during this study. In contrast and noteworthy were the interruptions and demonstrated cognitive time-sharing where nurses increased patient safety (Table 4.6).



## CHAPTER V

### DISCUSSION

This chapter provides a discussion of the findings and the application of those findings to practice and education. Findings associated with the research questions are discussed followed by methods lessons and implications. Recommendations for future research are suggested throughout the chapter. Limitations are discussed and finally, a summary of the chapter is provided.

#### **Research Aim One**

##### *Describe Situation Awareness during the Medication Administration Process*

The major theme phrase that emerged describing situation awareness level one (SA1) was the nature of the stimuli noticed with sub-themes reflecting types of stimuli including: visual, auditory, and interrupting thought stimuli or cues. The major theme phrase describing situation awareness level two (SA2) and dependent upon SA1 was the meaning assigned to the nature of stimuli noticed. Sub-themes revealed within the meaning assigned to the nature of stimuli noticed included uncertainty, relevance, and expectations. Anticipated or projected workload emerged as the major theme describing situation awareness level three (SA3).

#### **Research Aim Two**

##### *Describe Situation Awareness and Interruption Handling Strategies During the Medication Administration Process — SA1: Situation awareness, Interruption Handling and the Nature of the Stimuli Noticed*

Expertise, understanding and combating situation awareness demons, and situated cognition may explain patterns revealed among expert nurses not otherwise as apparent

among nurse with less than 24 months expertise. Direct care nurses representing both medical-surgical and critical care environments and staged by their peers as expert demonstrated - situated cognition, that is “productive thinking and knowledge retrieval which is called forth by and relevant to particular, concrete circumstances in the continuously changing situation at hand...relies on embodied skilled know-how as well as formal knowledge and is based on recognition of the nature of the situation” (Benner, et al., 2011 p. 558). Experts demonstrated a constant curiosity visually scanning to detect what was necessary to notice enabling them to manage their patients, their workflow, and their work environment. Detection to notice or perceive (SA1) visual, auditory, or interrupting thought stimuli is enhanced among experts as experiential knowing informs the need to set up systematic scans to stay up-to-date in terms of their knowledge of what’s happening now (Endsley, 2003).

Perception of cues or stimuli is fundamental to situation awareness and the cognitive work of the nurse. Noteworthy is the role of attention in situation awareness. Endsley (2003) asserts that one’s attention to information is prioritized based upon one’s perception of how important that information is perceived to be. Recall common behaviors noted among experts not otherwise noted among nurses with less than 24 months including learned patterns to scan that dictated how the expert nurse directed their attention and therefore noticed and chose to engage in interruption perceived to be important. Factors explaining situation awareness level one (SA1) to perceive visual, auditory, or interrupting thought stimuli may be influenced by the direct care nurse capacity to combat situation awareness demons including: attentional tunneling, memory

requisite trap, workload, anxiety, fatigue stressors, data overload, misplaced salience, and complexity creep (Endsley, 2003).

Experts examining situation awareness report the most causal factor related to situation awareness error was when all the information was present, but not attended to by the individual. Consider the nursing work environment and translation of factors determined to influence situation awareness level i.e. attentional tunneling, memory requisite trap, workload, anxiety, fatigue stressors, data overload, and misplaced salience (Endsley, 2003). Situation awareness is dependent upon one's ability to switch attention between different sources of information. Attentional tunneling, that is fixating on one set of information to the exclusion of other information could be applied to the cognitive work of nursing, nursing situation awareness and the nurse response to auditory, visual, or interrupting thought stimuli. Consider the data demonstrating patterns of scanning among direct care nurses enabling them to avoid attentional tunneling. Endsley proposes what is problematic with attentional tunneling and situation awareness is not the physical interference or interruption, but one's capacity to switch attention. This particular study design did not permit or reveal an understanding of attentional tunneling, situation awareness, and interruption handling during the medication administration process.

The requisite memory trap can negatively influence one's attention to the nature of auditory, visual, or interrupting thought stimuli (SA1) as significant error can result from processes or systems that rely solely on a person's memory for performance. People can typically hold  $7 \pm 2$  chunks (related pieces) in short-term or working memory and specific to situation awareness, many features need to reside in memory. That is, scanning requires that previously accessed information can be remembered and combined

with new information noticed. Short-term or working memory where the features of a particular clinical situation, for example, come together and are processed as a meaningful picture are informed by knowledge stored on one's long term memory combined with new information noticed or perceived – most commonly through scanning. Auditory information, for example must be remembered as it is not typically retrieved the way visual displays can be recalled. Noteworthy is the translation and application of the requisite memory trap and the association between an over-reliance on memory, one's learned patterns of scanning, and one's capacity to pay attention to the nature of auditory, visual, or interrupting thought stimuli.

Workload, anxiety, and fatigue stressors have been found to significantly tax situation awareness by initially reducing an already limited working or short-term memory negatively influencing one's ability to cognitively perceive or notice auditory, visual, or interrupting thought stimuli let alone assign meaning to the nature of stimuli noticed. Experimental control of the setting coupled with randomized design is recommended to understand the impact of interruptions on clinician cognitive workload including memory load (Coiera, 2012).

The relationship between data overload, attention, and situation awareness is well documented (Endsley, 2003) and worth translating and applying to the cognitive work of nursing. Data overload is a considerable challenge to situation awareness and dependent upon the rate or flow at which data changes creating the need for information intake and processing that might outpace the nurse's cognitive system to supply the need or requirement to perceive the nature and assign meaning to auditory, visual, or interrupting thought stimuli. The influence on situation awareness or cognitive problem proposed is

not the volume of information, but bandwidth (Endsley, 2003). Solutions may lie in the opportunity to understand the architecture of the nursing work environment and not how the size of the information pipeline is altered, but rather the flow or rate of information through the pipeline.

Misplaced salience or one's inability to perceive the compelling nature of information negatively influences situation awareness. Perception is alerted or salience is triggered with the color red, movement, and flashing lights. Solutions may lie in the design of systems enabling color or movement to draw the nurse's attention to particular information designing for situation awareness in nursing. However, experts in situation awareness caution that overuse of moving icons, flashing lights, and bright colors can result in misplaced salience and actually block competing signals and the need to attend to other more important information (Endsley, 2003).

Future research within a controlled environment and randomized design might expand our knowledge of nursing attention and specifically nurse situation awareness to perceive the nature of auditory, visual, or interrupting thought stimuli during medication administration processes and solutions to combat attentional tunneling, memory requisite trap, workload, anxiety, fatigue stressors, data overload, and misplaced salience.

*SA2: Situation awareness, Interruption Handling, and the Meaning Assigned to Stimuli Noticed*

Beyond simply perceiving the nature of auditory, visual, or interrupting thought stimuli perceived, situation awareness includes the integration of information and a determination of their relevance to the nurse's goals (SA2). Nurses with Level 2 SA have been able to derive relevant salience from Level 1 SA data perceived assigning relevance,

uncertainty, or expectations in relation to their particular goals. Expertise may explain assignment of meaning tendencies noted among direct care nurses staged by their peers as experts. Saturated knowing as a theme took shape as data revealed patterns where consistently the expert nurses assigned meaning to a culmination of subtle cues influencing a macro level of assigned meaning less apparent in nurses with less than 24 months experience. Direct care nurse experts do not simply know more, they know differently enabling them to see and sense make what might be otherwise invisible to direct care nurses with less than 24 months experience.

Experts propose goals are central to the development of SA and in an attentionally demanding work environment; perceived environmental cues may trigger new or adapted goals that need nurse attention. Consider interruptions. Consider the nurse in the midst of the medication administration process who notices the resident surgeon walking into another one of her patient's rooms to "just do staple removal." Consider the nurse's goals in the midst of the medication administration process and new goals influenced by her visual and auditory perception (SA1) and assigned meaning (SA2) illustrated as follows:

The resident came in during med pass and said he was just going to do staple removal. I had to see. Any time somebody comes into a patient room, you want to be there because you just never know. I knew it might go more in depth than just an actual staple removal itself...knowing that it was a surgical intern, they are knowledgeable, but sometimes they only focus on the task at hand, kind of like a new nurse.

Noteworthy, the nurse made a decision to engage immediately based upon the nature of the stimuli perceived and assigned meaning to the nature of stimuli perceived. The effects of interrupting the medication administration process at that particular time are not known. Attention experts assert that the cost of switching between tasks (for

example between administering medications for one patient and sensemaking with a resident surgeon on surgical wound evaluation for another patient) is greatest when stimuli are compatible with each other when no signal or cue is provided to signal for the performer which task to prioritize. Further, in the absence of external cues informing how one should prioritize (decision to attend influencing SA), performers tend to rely on cognitive rehearsal in working memory to remind themselves which task to prioritize (Endsley, 2003). Recall the saturation of data demonstrating a preference among direct care nurses staged as experts “who knew” and chose to engage informed by the nature of stimuli perceived and experiential knowing informing assigned meaning of the nature of stimuli perceived. The criticality of SA2 is noteworthy as nurse experts demonstrate a knowing about searching and scanning enabling pattern recognition given the nature of stimuli perceived, and how to assign meaning not just to limited elements, but the synthesis of elements and situation in context (Klein, 2003; Endsley, 2003). The need for future research examining the complexity of interruptions, the positive and negative effect of interruptions on patient care including medication administration is evident in these research findings and supports state of the interruption science research findings reporting by Hopkinson and Jennings (2013).

*SA3: Situation awareness, Interruption Handling and Workflow Priorities*

The temporal aspects of situation awareness were expressed in the form of nurse perception of time and temporal dynamics influencing patient-centric or team and task-centric workflow priorities. Endsley’s definition of situation awareness includes the phrase “within a volume of space and time” (Endsley, 2003 p. 7). Consider application to nursing, that is attention and situation awareness projection or anticipated interventions

(SA3) based upon space (nature of stimuli location – how far away from the nurse), but also how soon the nature of that particular stimuli will have an impact on the nurse goals and tasks. Consider the following example where the nurse self-interrupted in the midst of the medication administration process for another patient based upon her knowledge of space and time in coordination with her goals for another patient:

I happened to hear some people walk down the hallway. I saw the two nurses... blue surgical scrubs (SA1). I knew they were the IV Team and I also knew that my patient in 21 needed an IV because he did not have any access. I need to make sure they were seeing my other patient.

Expert nurses appeared to express frequent curiosity, which was not always detected with the participants with less than 24 months of experience as a registered nurse (Benner, et al., 2011; Wickens, 2008). Similar to prior research, experts nurses at the SA3 level clearly demonstrated clinical forethought or seeing the unexpected (Benner, et.al., 2011; Weick and Sutcliff, 2007) and prioritization described in previous research (Wickens, 2008; Ebright, et.al., 2003; Ebright, et.al., 2004). In addition, expert nurses illustrated a patient-centric workflow foreground in contrast to a team or task-centric workflow foreground.

However limited, research has begun to reveal the relationship between working memory and SA3 projection or anticipation (Gutwiller, et.al). Pattern matching and mental schema influenced by long term memory (experts) is readily recalled in the presence of cues or the nature of stimuli perceived. Additionally, experts demonstrate proficiency in selective listening (SA1-auditory cue) increases working memory capacity. Greater working memory capacity (higher span) enables attentional flexibility facilitating effective cognitive time-sharing (Wickens, 2008).



## **Interruption Handling Selection and Cognitive Time-Sharing**

These research findings affirm previous research demonstrating that medication administration is inseparable from other nursing work and challenges current platforms reinforcing the reduction of interruptions based upon limited evidence quantifying the relationship between interruptions, medication administration error and patient harm (Jennings, et al., 2011; Hopkinson and Jennings, 2013). Attention and specifically SA and cognitive time-sharing is facilitated by spatial abilities and visual scanning (Wickens, 2008; Endsley, 2003). Cognitive time-sharing and task-switching in nursing may also be influenced by individual differences in verbal abilities as verbal abilities demonstrate a pattern of proficient executive cognitive control.

### **Interruption Handling Strategies: Selection Considerations**

Skill automation may explain the natural tendency among some participants to choose multi-tasking or even engagement as the preferred interruption handling strategy. Engagement was the predominant interruption handling strategy among experts (IHS of choice 62-100% of interruptions) in contrast to nurses with less than 24 months experience (48-75%). Skill automation may enable the expert nurse to more effortlessly engage and multi-task. Automaticity has been defined as: “ability to perform a task while putting little thought into it,” (Wright, 2011, p 485) and a defining characteristic of an expert (Endsley, 2003; Wickens, 2008). Experts (Endsley, 2003; Wickens, 2008), contend that experience contributes to SA enabling the development of mental models and goal-directed processes that can lead to automaticity in mental processing – that is, the pattern-recognition/action-selection sequence becomes routine to the point of becoming automatic.

Wickens (2008) asserts to the extent that two tasks are cognitively resource-demanding, allocating more cognitive resources to one task will improve performance on that particular task, but degrade performance on the secondary task as a result of withdrawal of cognitive resources from the secondary task. Further, two people performing the same task can have identical performance, yet one may do so with spare attentional resources left to allocate to concurrent tasks (Wickens, 2008). Automatic tasks can be time-shared (divided attention) efficiently with other resource-demanding tasks i.e. walking and decision-making or for example in this study, pulling medications while answering the phone or administering medications while noticing and making a decision to engage with the other patient's physicians, or pulling medications while collaborating with colleagues in the medication room or answering the phone while completing intravenous medication tasks.

Automaticity or automatic processing is the result of consistent cognitive mapping and practice. For example, less familiar or practiced tasks – before consistently mapped or practiced requires cognitive resource loading. In contrast, tasks – after consistently mapped and practiced – become automatic and might explain the ease and prevalence of engagement as an interruption handling strategy. Engagement and multi-tasking in response to the nature of stimuli perceived may be the expected response depending on the particular nursing work or practice environment.

Today's healthcare customers including payors, expect high performance in quality, the patient's experience or patient satisfaction, and at low costs. Financial consequences awarded to hospitals associated with performance in quality, satisfaction, and costs are remarkable and may influence the nursing work environment and

expectations for nursing attention. Consider two examples of data demonstrating participant attention to the nature of auditory stimuli – the phone and assigned expectations:

If I'm just, you know, administering medicine, I'll usually excuse myself to answer the phone. It's expected.

It was a transport call during med pass. It's expected. If I'm with patient one and administering meds, transport calls (about another patient) and they say, "We're ready for him to go to CT." We take them down. Everybody's STAT. Everybody wants their CT now, today.

High reliability within healthcare is expected within an environment –that for the most part – is absent high reliability design (Vogus, Sitterding, and Everett working paper). Additionally, the meaning assigned to the nature of stimuli perceived may be the result of the current nursing work environment and requirements for responsiveness such as the prevalent response to auditory - phone interruptions among both groups of participants. Designing for situation awareness in the midst of attentionally-demanding nurse work environments is necessary. These findings support future research examining the effect of recommendations proposed by Li and colleagues (2012) to minimize the disruptive effects of interruptions in clinical settings including: 1) avoidance of interruptions at positions requiring high working memory demands; 2) utilization of practice on tasks to minimize disruption of interruption i.e. practicing a highly procedural task strengthening associated task memory; 3) interruption-handling training; and 4) development and provision of environmental cues aiding recovery from interruptions.

### **Interruption Handling Selection: Strategies and Effects**

Findings reported in this study support previous research demonstrating the call for a framework to understand the complexity of interruptions and the effects of

interruptions given assumptions that interruptions have only negative affects on nursing practice and patient care and evidence of only one source of empirical evidence demonstrating the statistically significant relationship between medication administration error and interruptions (Westbrook, et al., 2010; Li, et al., 2012; Hopkinson and Jennings, 2013. In a systematic review of the psychological literature on interruption and its patient safety implication, Li and colleagues reveal the effects of interruptions in healthcare predominantly to include: working memory load, interruption similarity, interruption position, interruption modality, practice and experience, and interruption handling strategies. Decreased primary task performance (i.e. medication administration) may be negatively influenced if interruptions occur during particularly high working memory load. Li and colleagues (2012) proposed the effect of the interruption and relationship to working memory load depend on whether the interruption is similar to the primary task (interruption similarity) and where in the primary task the interruption occurs (interruption position). Interruption modality is also proposed to influence the effect of interruptions, that is that nature of an interruption presenting to a different modality from the primary task reduces disruption to performance. For example, a nurse may select to engage or multi-task taking a phone call while engaging in a visually oriented task of medications verification or electronic barcode scanning. In contrast, error may be more likely when taxing like modalities as in the example of a nurse verifying medications for his/her patients when interrupted by a nurse colleague to visually verify high-risk medications given required independent double check verification policies. Li and colleagues (2012) proposed less cognitive disruption with cross-modality interruptions because they utilize non-overlapping cognitive resources.

Understanding nurse situation awareness and the effects of interruption handling or task switching was not the intent of this research study. However, future research in controlled environments exploring effects of task-switching and interruptions is necessary to expand our understanding of the association between situation awareness, interruptions, task-switching, and patient safety.

### **Methods Lessons**

Observation and videography enabled the investigator to capture authentic behavior on the part of the nurse during medication administration. Observation and videography informed interruption case selection. Videography was integrated as a data collection method given the concern that there would be limited or variation in recall of a non-critical incident (medication administration) among usual RNs on a usual day on an acute care unit. Observation coupled with videography was intended supplement completeness and accuracy of recall (Colligan, et al., in press). The risk of the potentially intrusive nature of observation and videography were balanced by the benefit of completeness and accuracy of recall among participants. Goal-directed task analysis was helpful in light of the discovery that nurse goals extended included, but extended beyond safe medication delivery.

### **Implications for Future Research**

These study findings support the need for future research examining the complexity of interruptions and methods to understand the positive and negative effect of interruptions on patient care including medication administration. Further, these findings warrant future study to explore the effects of task-switching and interruptions to expand our understanding of the association between situation awareness, interruptions, task-

switching, and patient safety. These findings support future research examining the effect of recommendations proposed by Li and colleagues (2012) to minimize the disruptive effects of interruptions in clinical settings including: 1) avoidance of interruptions at positions requiring high working memory demands; 2) utilization of practice on tasks to minimize disruption of interruption i.e. practicing a highly procedural task strengthening associated task memory; 3) interruption-handling training; and 4) development and provision of environmental cues aiding recovery from interruptions. In terms of future research understanding situation awareness and nursing work, research within a controlled environment and randomized design might expand our knowledge of nursing attention and specifically nurse situation awareness to perceive the nature of auditory, visual, or interrupting thought stimuli during medication administration processes and solutions to combat attentional tunneling, memory requisite trap, workload, anxiety, fatigue stressors, data overload, and misplaced salience. Additionally, implications for nursing education research are implied. Future research may include the design of nursing education for the purpose of identifying specific skills and perceptive patterns in the context of the cognitive nursing work situation and the nurse expert strategies for dealing with those particular cues in context. Additionally, future research may include the design of interdisciplinary collaboration designing curriculum for attentional flexibility (cognitive time-sharing skill).

### **Limitations**

Limitations include the sample size and sample characteristics that may have influencing study findings and interpretation. Interruption is identified as a break in

nursing performance. What's unexplained is an understanding of what information was present – before the nurse – but not attended to by the nurse.

### **Chapter Summary**

These research findings describe the cognitive work of nursing – that is, situation awareness, and interruption handling during the medication administration process. These research findings substantiate the requirement to understand and allow value-added interruptions. Klein (2003) asserts and these study findings affirm support ongoing research to understand situation awareness within the cognitive work for four reasons: 1) situation awareness is linked to performance; 2) situation awareness (due to limited working memory or attention) may be linked to error); 3) situation awareness is related to expertise; and 4) situation is the basis for decision-making (Klein, 2003 in Endlsey).

The results of this study contribute to the growing body of literature describing the impact of the cognitive work of nursing on patient care delivery and implications for patient care safety. This research may serve as a baseline for explanatory research – ultimately informing quantitative question, design, and interventions to influence situation awareness, cognitive time-sharing, cognitive stacking, and decision-making during the medication administration process. Primary research findings reveal the description of SA prior to and during medication administration and including the selection of interruption handling strategies during medication administration. Differences in SA associated with expertise were revealed and consistent with previous, limited research in nursing (Sitterding, et al., 2012). Cognitive time-sharing was discovered and consistent among all participants. The concept of situation awareness as significant and applicable to nursing was further substantiated through this research. The

interaction between situation awareness and stacking was reinforced as described in previous research (Sitterding, et al., 2012) as was the concept of situation awareness within the cognitive work of nursing model (Ebright and Sitterding, working paper).

Characteristics of the contribution of this research to the body of nursing science include the following: 1) Recontextualization of an existing research technique (uniqueness of CTA methods); 2) Demonstration of a concept within a model (the concept of situation awareness in the cognitive work of nursing – working paper – model); 3) Codification of the obvious, that is providing evidence (SA, IHS, and cognitive time-sharing in nursing) for the phenomena believed to be true, but absent substantial evidence; 4) Demonstrated taxonomy proposed in previous research; and explicit implications and future research.



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## CURRICULUM VITAE

Mary Cathryn Sitterding

### EDUCATION

DEGREE	MAJOR	INSTITUTION	DATE
ASN	Nursing	Indiana University School of Nursing	1984
MSN	Adult Health: Clinical Nurse Specialist	Indiana University School of Nursing	1999
PhD	Nursing Science	Indiana University	2014

### EMPLOYMENT

3/2007 – Current      Magnet Program Appraiser  
American Nurses Credentialing Center, Washington, DC  
The Magnet Recognition Program affords important national recognition to health care organizations that demonstrate sustained excellence in nursing care. The Magnet Recognition Program is based on the American Nurses Association's *Scope and Standards for Nurse Administrators (2003)*.

#### Indiana University Health

08/2011 – Current      Executive Director, Nursing Research, Professional Practice, and Operational Improvement  
This position in partnership with the Chief Nurse Executive exists to design, implement, and sustain system structures and processes ensuring excellence in professional practice including, but not limited to excellence in nursing and patient care quality, efficiency, effectiveness, and research. In partnership with the Chief Nursing Executive, this role is responsible for adherence to professional nursing practice model and nursing excellence principles demonstrated in ANCC Magnet sources of evidence. This role is responsible for the design and execution of processes, structures, and roles enabling system-wide role model nursing research and evidence-based nursing and patient care practice.

09/2008 – 08/2011      Director, Nursing Research and Professional Practice  
The purpose of this position was to promote the advancement of cost-effective, quality patient care and services.

09/2008 – Current      Magnet Program Director  
Indiana University Health  
Magnet Redesignation 2009

Magnet Redesignation anticipated (site visit 01.2014)  
In partnership with the Chief Nursing Executive, responsible for adherence to professional nursing practice model and principles demonstrated in ANCC Magnet Sources of evidence. In partnership with CNE, responsible for successful submissions Fall 2008 and Summer 2013.

## Columbus Regional Hospital

05/2006 – 08/2008 Director, Nursing Practice, Research, and Innovation

Responsibilities: Partner with Senior Leadership to assure that all nursing innovation trials assigned are aligned with CRH priorities, on time, and on budget; Partner with CNO to assure Magnet Program adherence; Unit-Based Case Management Role Effectiveness; CNS role development, and individual CNS practice; Partnering with the CNO in the direction, selection, implementation, and evaluation of nursing inquiry and innovation; and collaboration with Clinical Nurse Specialists, the Chief Medical Officer, the Medical Director for Quality Management, and Chief Nursing Officer in planning, organizing, directing, and evaluating clinical innovations in order to provide patient care in accordance with the mission and policies of Columbus Regional Hospital.

06/2006 – 2008 National Surgical Quality Improvement Program Director

In partnership with Surgery Medical Director, responsible for NSQIP data entry integrity in alignment with ACS – NSQIP Program. Responsible for analysis and dissemination of semi-annual report; review with key stakeholders; design, implementation, and evaluation of strategies aimed at surgical care excellence evidence by O-E ratios at or better than benchmark.

12/2003 –2008 Stroke Center Co-Chair

Maintain JCAHO Stroke Center Designation  
Evidence-based stroke care team leadership. Successfully led the organization through 1 planned and 1 unplanned site visit resulting in 2 Stroke Center Certifications.

01/2004 – 2008 Magnet Program Director

Magnet Designation 2003

Magnet Redesignation 2008

In partnership with the Chief Nursing Officer, responsible for adherence to professional nursing practice model and principles demonstrated in ANCC Magnet Sources of evidence. In partnership with CNO, responsible successful submission in 2003 and 2007.

01/2004 – 2008 National Database for Nursing Quality Indicators

NDNQI Site Coordinator

Responsibilities: On time quarterly submission of reliable data that includes but is not limited to nursing hours per patient day, certifications, educational preparation as well as fall and pressure ulcer indicator and incidence information. Responsible as well for dissemination of data and partnership with Chief Nursing Officer and Director Nursing in identification of opportunities for excellence.

05/2001 – 2008 Columbus Regional Hospital, Columbus, Indiana

Leader, Advanced Practice and Clinical Case Management

Duties: Direct the selection, implementation, and evaluation of clinical inquiry and innovation; ensure that all clinical inquiry and innovation is in alignment with CRH

strategic goals and objectives; oversee clinical nurse specialist patient, provider, and system outcomes; ensure clinical nurse specialist patient, provider, and system competency; oversee unit-based case management care delivery role; continued Clinical Nurse Case Management responsibilities.

01/1995 – 05/2001 Clinical Nurse Case Manager, Neuroscience and Orthopaedics  
Duties: Design and manage neuroscience and orthopedic care across the continuum.

03/1992 - 01/1995 Referral Coordinator, Physical Medicine and Rehabilitation  
Duties: Comprehensive functional health/physical assessments on potential candidates for inpatient rehabilitation services within 10 county service area. Partner with payors to achieve reimbursement for rehabilitation services. Evaluate the effectiveness of intake and orientation program for the inpatient rehabilitation patient population.

03/1990 - 03/1992 Education Coordinator, Physical Medicine and Rehabilitation  
Duties: Collaborate with PMR leadership to assess needs and coordinate patient and staff educational opportunities. Develop, implement, and evaluate inpatient rehabilitation nursing orientation program and standards.

05/1984 - 03/1990 Primary Care Nurse, Neurological Rehabilitation

#### APPOINTMENTS

2012 – Current American Organization of Nurse Executives  
AONE Foundation: Research Committee Member

2009 - 2011  
American Organization of Nurse Executives  
Patient Safety and Quality Subcommittee Member

08/2000 – Current Adjunct Assistant Professor, Department of Adult Health, Indiana University School of Nursing

01/2002 – 12/2005 Co-Chair, Healthy Communities Council, Bartholomew County Healthy Communities

#### PROFESSIONAL ACTIVITIES

American Nurses Association, member  
National Association of Clinical Nurse Specialists, member  
American Organization of Nurse Executives, member  
Central Indiana Clinical Nurse Specialists, member  
Sigma Theta Tau International, member

## AWARDS

Award: *Excellence in Practice Award* presented on behalf of Sigma Theta Tau Alpha Chapter. April 21, 2006.

Nomination. *Clinical Nurse Specialist of the Year* on behalf of National Association of Clinical Nurse Specialists. March 2007.

Award: *Indianapolis Patient Safety Coalition Heroes Award* for system excellence in HAPU Prevention December 2010.

Award: *Indianapolis Patient Safety Coalition Heroes Award* for Medication Safety and the Systematic Integration of ISMP II Recommendations decreasing Hospital-Acquired Medication Error and Harm. December 2011.

## SCHOLARLY WORK

### Paper Presentations (\* refereed):

\*Sitterding, M. & Smith, D. (1997). Bending to Meet the Kneeds of the Total Joint Replacement Population. 18th Annual Congress, National Association of Orthopaedic Nurses. San Francisco, California.

Sitterding, M. & Rapp, D. (1997). Clinical Case Management. VHA National Showcase of Case Management Models Symposium. Dayton, Ohio.

\*Sitterding, M., Guthrie, A., Smith, D., & Meyer, C. (1999). NIC/NOC: Managing Change in Patient Education Across the Continuum. 19th Annual Congress National Association of Orthopaedic Nurses. Atlanta, Georgia.

Sitterding, M. (1999). An Interdisciplinary Approach to Stroke Prevention and Care Across the Continuum. VHA National Stroke Care Symposium. Dayton, Ohio.

\*Pappas, J. and Sitterding, M. (2001). A Non-Diseased Based Approach to Congestive Heart Failure Management. Annual Conference of National Association of Clinical Nurse Specialists. Indianapolis, Indiana.

\*Sitterding, M. and Fields, C. (2001). Outcome Management: Surgical Site Infection Rate Reduction. Annual Conference of National Association of Clinical Nurse Specialists. Indianapolis, Indiana.

\*Sitterding, M. and Maupin, J. (2001). Pain Management: An Organizational Approach. Annual Conference of National Association of Clinical Nurse Specialists. Indianapolis, Indiana.

Sitterding, M. (2001). Change Strategies Influencing Surgical Site Infection Rates. (INVITED) Nursing Leadership Institute, VHA. Indianapolis, Indiana.



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Hajewski, C. & Sitterding, M. (2003) A Nursing Service Journey Toward a Professional Practice Model Influencing Magnet Designation. (INVITED) Magnet Education Program, VHA. Indianapolis, Indiana.

Sitterding, M. (2003). Clinical Inquiry and Research Application. (INVITED) Magnet Education Program, VHA. Indianapolis, Indiana.

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Sitterding, M. (2005). Professional Nursing Practice Model: The Journey Part II. ANCC Magnet Conference. Indianapolis, Indiana.

Sitterding, M. (2005) Clinical Case Management within a Professional Nursing Practice Model. Medical-Surgical Nurse Meeting – Southern Indiana Chapter Columbus, Indiana.

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\*Sitterding, M. (2006). Keeping Patients Safe: Positioning the Bedside To Achieve and Sustain Accuracy with Medication Reconciliation. 10<sup>th</sup> Annual ANCC Magnet Conference. Denver, Colorado.

Sitterding, M. (2006). Surgical Care Improvement: Achieving Reliability in the Assessment and Administration of Beta Blockers among Eligible Patients. (INVITED) American Osteopathic Association. Las Vegas, Nevada.

Resar, R., Sitterding, M. (2008) INVITED. Risk Resilience. 20<sup>th</sup> Annual National Forum on Quality Improvement in Health Care. Orlando, Florida.

Sitterding, M. and Ebright, P. (2010) Patient Safety and the Cognitive Work of Nursing: Advances in Nursing Science and Implications for Organizational Support. 43rd Annual Meeting American Organization of Nurse Executives. Indianapolis, Indiana.

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Sitterding, M. (2012). The Cognitive Work and Situation Awareness in Nursing. (INVITED). Progressive Pediatrics. Indianapolis, Indiana.

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#### Poster Presentations:

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\*Sitterding, M. (1997). Building Better Bones: Opportunities Beyond the Walls of the Acute Care Pathway. 18th Annual Congress National Association of Orthopaedic Nurses. San Francisco, California.

\*Sitterding, M. (2001). Differences in Perceived Threat, Self-Efficacy, and Outcome Efficacy Across Stages of Change for Following a Low Cholesterol Diet Among Post Menopausal Working Women. Annual Conference of National Association of Clinical Nurse Specialists. Indianapolis, Indiana.

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\*Sitterding, M. (2006) Next Generation Professional Practice Model Part II. 9<sup>th</sup> Annual ANCC Magnet Conference Miami, Florida.

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Sitterding, M. (2007). A Journey Toward the Pursuit of Surgical Care Excellence: A Community Hospital Exemplar. 19<sup>th</sup> Annual National Forum on Quality Improvement in Health Care. Orlando, Florida.

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Peer Reviewer:

2003 — Current Reviewer: CNS: The Journal for APNs

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