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Human Factors Contributing to Nursing Errors

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HUMAN FACTORS CONTRIBUTING TO NURSING ERRORS

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Abstract

HUMAN FACTORS CONTRIBUTING TO NURSING ERRORS

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There has been considerable focus on reducing errors in the hospital setting over the last two centuries, but errors continue to occur at an alarming rate. Two articles are discussed that explore nursing errors. The purpose of these studies was to identify human factors that cause nursing errors and to identify the constructs of likelihood to cause error, ability to intervene, importance, and commonness relating to human factors causing errors.

The first paper describes a Delphi Study which examined the likely causes of nursing error using an expert group (n=25) of Quality Assurance, Risk Management,

Patient Safety, and staff nurses. The second paper describes a study in which a broader panel of hospital-based nurses (n=393) took an online survey evaluating likelihood to cause errors, intervenability, importance, and commonness. Factor analysis was done to determine general themes related to human factors likely to cause errors and how they related to the specific demographic findings of shift worked, education level, and having previously made a nursing error.

The Delphi survey, through two iterations, identified 24 causes of nursing errors. The need for further study in the area of human factors contributing to nursing errors was recognized. The survey of hospital-based registered nurses was used to evaluate these factors in view of likelihood to cause error, intervenability, importance, and commonness. The top ten factors were identified for each. Factor analysis of data resulting from the Likelihood to Cause Errors Scale identified four themes: loss of focus, unhealthy environment, interpersonal deficits, and being overwhelmed.

Chapter 1. Overview of the Research Study

Overall Purpose of the Study

Nursing errors have been studied for many years in an effort to improve patient safety. The Institute of Medicine's (IOM) 2000 report "To Err Is Human" (Kohn, Corrigan, & Donaldson, 2000) renewed emphasis on prevention of errors as a key safety measure in healthcare. Despite system changes to decrease the incidence of errors, an estimated 1.5 million patients are injured each year in the United States (IOM, 2006). Current emphasis has been to study system factors and create fail-safe tools for nurses to use to prevent errors.

Yet there is a human side to nursing that makes the nurse vulnerable to mistakes that occur simply because of human nature. These factors need to be identified and addressed in order to better understand the causes of nursing error. A review of the current practice and literature is included. A Delphi study was done with a small group of experts (n=25) and then reaffirmed by a larger group of nurses who expanded on their impressions of likelihood for error to occur, as well as the intervenability or ability to fix or change the factor, error importance, and the commonness of the problem.

Introduction of Articles

Two articles are included that address the findings from this research. The first article, *Using Delphi Technique to Identify Human Factors Contributing to Nursing Errors*, describes a Delphi study undertaken to identify common human factors which are

most likely to cause a nursing error using two surveys of a group of nurse experts (n=25). The current culture around safety measures taken to reduce errors is examined. This Delphi Study examined the likely causes of nursing error using an expert group of Quality Assurance, Risk Management, Patient Safety, and staff nurses. Their answers through two iterations identified 24 reasons for nursing errors. Findings also suggested more research in the area of human factors contributing to nursing errors was needed.

The second article, *Hospital Nurses' Perceptions of Human Factors Contributing to Nursing Errors* describes a broader survey of a larger group of nurses (n=393) to examine the hospital nurses' opinions of the factors identified by the expert group and to explore importance, ability to intervene, and commonness. The causes of nursing errors are reviewed, including issues with human fallibility and system fallibility. The manner in which the healthcare community is in pursuit of ways to impact these causes is described (Bates, 2007; Bennett, Dawoud & Maben, 2010; Biron, Loiselle & Lavoie-Tremblay, 2009).

Intervenability, importance, and commonness scales are reviewed, and the top items in each scale are presented. Factor analysis of the Likelihood to Cause Error Scale revealed four themes: loss of focus, unhealthy environment, interpersonal deficits, and being overwhelmed. This study emphasizes those human factors that must be addressed in order to increase the environment of safety surrounding patients, nurses, and the whole healthcare team.

Chapter 2. Using Delphi Technique to Identify Human Factors Contributing to Nursing Errors

Abstract

Patient safety is one of the foundations of nursing. Nursing errors may cause patient harm and can be devastating for the nurse. While system and equipment failures do contribute to errors, we know that human factors are involved, including some factors that are uncontrollable and part of human nature. This Delphi Study examined the likely causes of nursing error using an expert group (n=25) of Quality Assurance, Risk Management, Patient Safety, and staff nurses. Their answers through two iterations identified 24 reasons for nursing errors.

Keywords: Human factors, nursing errors, Delphi survey

Using Delphi Technique to Identify Human Factors Contributing to Nursing Errors

Since the institution of nursing in the 1800's when Florence Nightingale campaigned for better health care and sanitation, nurses have been dedicated to caring for their patients in the safest manner possible. Patient safety is one of the foundations of nursing. The Institute of Medicine (IOM) report "To Err Is Human" (Kohn, Corrigan, & Donaldson, 2000) renewed emphasis on prevention of errors as a key safety measure in healthcare. Since nursing personnel have more patient contact than any member of the multidisciplinary team, they are frequently involved in the identification and remediation of nursing errors. Nurses may or may not be the direct cause of errors. Understanding how human factors contribute to nursing errors may promote greater accuracy in nursing care delivery systems. A Delphi Study was used to develop and define the context of nursing errors in a large hospital system. This study will provide a theoretical basis for error identification and prioritization in the search for a framework to address the issue of human errors in nursing care.

Hospital nurses spend the majority of their time in concentrated interaction with patients. They are involved in the most intricate processes of patient care, yet the nursing shortage and basic economics have resulted in an environment where nurses receive increasingly heavy assignments and contend with a growing complexity of electronic tools and media. Errors occur, and when they do, the nurse involved carries not only the memory of the event, but often a great deal of guilt associated with the error (Arndt, 1994; Johnson, Tran, Thuy, & Young, 2011). Understanding how human factors

contribute to error occurrence may support ongoing change in the approach of error mitigation in the future.

The need to mitigate nursing errors is compelling. Despite system changes to decrease the incidence of errors, an estimated 1.5 million patients are injured in hospitals each year in the United States (IOM, 2006). The number of global injuries is unknown and has not been studied. The World Health Organization's Patient Safety Methods and Measures for Patient Safety Work Group (2009) looked into human factors and identified ten topic areas to be developed as a global strategy. These ten included four individual worker factors: situational awareness, decision making, stress, and fatigue. Nursing science has begun to explore human factors, but more research is needed.

Purpose of the Delphi Study

The purpose of this study was to identify the issues involved in nursing errors in the hospital setting. The goal is to reduce the presence or recurrence of errors in the delivery of nursing care. Nurses must understand human factors that contribute to nursing errors to understand how to control for these innate human cognitive processing constraints. National initiatives have focused on creating a "Culture of Safety" in the hospital workplace. Human fallibility and system fallibility have been the subject of an abundance of research, yet nursing errors continue to occur. Exploring human factors and designing nursing practice around controls for human processing failures may assist in providing a higher level of patient safety.

Review of the Literature

Promoting a Culture of Safety

Patient safety has become one of the national priorities in healthcare today. Health care leaders inside the federal government and from corporate America have joined the effort to protect the vulnerable patients who enter the U.S. health system. The Joint Commission for the Accreditation of Health Organizations (JCAHO) initiated Sentinel Event Alerts in 1998 in the pursuit of a culture of safety. To date, 51 Sentinel Event Alerts have been published, the latest focusing on preventing unintended retained foreign objects. The JCAHO publication of the monograph "Improving Patient and Worker Safety: Opportunities for Synergy, Collaboration and Innovation" in 2012 focuses on safety for both patients and nurses in the workplace. This comprehensive publication calls for development of evidence-based guidelines and recommendations for practice through systematic literature review, expert consensus panels, and research conferences.

Patient safety issues have caught the attention of governmental entities as well. The Agency for Healthcare Research and Quality (AHRQ) authorized the formation of Patient Safety Organizations (PSOs) in The Patient Safety and Quality Improvement Act of 2005 (Patient Safety Act). PSOs are tasked to improve the quality and safety of patient care through non-punitive reporting and analysis of errors and near misses (AHRQ, 2013). Nurses spent many years in a "shame on you" environment when reporting an error. Reporting an error resulted in guilt and perceived recriminations, lessening the likelihood that nurses would report an error (Arndt, 1994). Changing the patient safety culture to encourage error reports without placing blame on the reporting

nurse is integral to having an accurate understanding of the number and type of errors actually occurring. Observation of reported errors has led to advances in the broad understanding of causal factors through the work of the PSOs.

Currently, 78 PSOs are listed on the AHRQ website. The Institute for Safe Medication Practice (ISMP) was formed in 1975 and designated as a PSO in 2005. It is dedicated to the prevention of medication errors. Their focus on voluntary reporting of errors, understanding the root cause of those errors, and sharing lessons learned across institutions has been highly influential. ISMP's work to identify "high-alert" medications, eliminate error-prone abbreviations, and attention to look-alike, sound-alike medications have been major steps in the prevention of medication errors. The National Patient Safety Foundation (NPSF), another PSO, was founded in 1997, and designated as a PSO in 2005. NPSF publishes the *Current Awareness Alert* twice monthly, a peer-reviewed journal called *Focus on Patient Safety*, and the quarterly *Patient Safety InSight* journal for the American Society of Professionals in Patient Safety. These publications serve to promote collaboration across the healthcare spectrum to create a world where patient and workers are free from harm (NPSF, 2014). National organizations have taken their safety commitment seriously and are working with specialty groups and hospitals systems to increase the culture of safety for patients.

Hospital Systems Initiatives

Identifying hospital systems as a source of hospital errors has been a recent phenomenon. Many times, the system-wide changes put in place to cut costs and improve efficiency are also fraught with risk for patient errors. One anticipated solution to this issue is the advent of electronic medical records, required by the Center for

Medicare and Medicaid (CMS). The available systems are largely focused on electronic documentation. There are multiple companies that provide such electronic medical record systems, but currently these products do not electronically talk to one another; so the future goal of CMS of one integrated electronic system is far from reality. All members of the healthcare team are being required to learn these systems with significant time and cost commitments. Duke University Health System and Boston-based Partners HealthCare will each pay $700 million and the University of California, San Francisco, will pay $150 million to implement these requirements (Shaywitz, 2012).

In spite of the staggering costs of electronic health record systems, it is unlikely that nursing care will be more efficient or result in safer patient care. In fact, most studies indicate that electronic documentation takes as much or more nursing time (AHRQ, 2009). It is estimated that 25% to 75% of nursing time is spent on documentation (Battisto, Pak, Vander Wood, & Pilcher, 2009; Final Report, 2006; Maryland Statewide Commission on the Crisis in Nursing Workplace Survey 2005: Munyisia, Yu, & Hailey, 2012). Documentation may be more complete and legible with electronic charting, but it has not automatically translated into improved patient care. Duffield (2011) found that a decrease in time spent with patients was linked to a negative impact on patient outcomes, including medication errors.

Healthcare administrators and nursing leaders in the United States continue to search for ways to improve patient safety. The *Journal of Nursing Administration* and *Nursing Administration Quarterly* published 127 articles on patient safety in the past five years. One of the common threads in these articles is the use of technology to prevent errors. Computerized technology is seen as one way to interrupt the error pathway.

Intravenous therapy pumps and patient controlled analgesia (PCA) pumps were among the first technologies to enter the nursing scene. Counting drip rates and calculating dosages became a thing of the past as automation took over. In a study at Duke University (Prewitt, et al., 2013), researchers found a 72% decrease in self-reported errors after smart-pump PCA technology and computerized provider order entry (CPOE) were instituted. Hicks, Sikirica, Nelson, Schein, and Cousins (2008) reviewed 919,241 medication errors from 2000 to 2005 looking at the contribution of PCA technology. They found that human factors were still overwhelmingly the cause of errors, with PCA technology responsible for only 1% of errors, equipment 19.5%, and product packaging 16.1%. Distractions (37.8%) and inexperienced staff (26.3%) were the primary human factors involved in the errors. Nevertheless, technology continues to hold promise for mitigation of at least some of the issues surrounding hospital errors.

The advent of computerized provider order entry has been purported to reduce medication errors by up to 40% (King, Paice, Ranngrej, Forestell, & Swartz, 2003; Wolf, 2007). Galanter, Falck, Burns, Laragh and Lambert (2013) found that use of CPOE intercepted 0.25 wrong-patient errors per 1000 medication administrations. On the other hand, there have been reports of increased patient risk due to system errors with CPOE. In a 4.5 year study involving 90,001 recorded medication errors (Santell, Kowiatek, Weber, Hick, & Sirio, 2009), the use of CPOE was found to create new opportunities for errors to occur, especially in the area of duplicate orders. Wetterneck, et al. (2011) reported that medication errors actually increased from 2.6% to 8.1% after implementation of CPOE primarily due to duplicate orders placed. It is clear that

sophisticated technology is no guarantee that human factors will be controlled and errors prevented.

Human Factors in Error Management

"Humans commit errors for a variety of known and complicated reasons" (Kohn, Corrigan and Donaldson, 2000, p. 65). Brous (2008) stated that "unintentional human errors occur in clinical practice and are inevitable" (p. 5). Understanding the literature base for nursing errors provides a lens through which human factors can be studied. A search of CINAHL, Medline, PsychInfo, and Religion and Philosophy Collection on medical errors produces 3,941 articles. When human factors was added as a limiting search term, only 30 articles resulted. Two of these articles related to individual human factors, specifically number of patients assigned and distraction, as a cause of medical errors (Holden et al., 2011; Scanlon & Karsh, 2010). Both studies recommended further research into human factors.

Used in the medical literature, human factors broadly refer to any and all human and system fallibilities that relate to error. Failure to follow policies and procedures, intentionally as an act of positive deviance (Gary, 2013) or unintentionally as an oversight, is a human factor that may produce error. Other human factors include distraction and interruption (Bennett, Dawoud, & Maben, 2010). Biron, Loiselle, and Lavoie-Tremblay (2009) observed an average of 6.7 work interruptions per hour during medication administration.

The system fallibility issues that are part of the overall human factors perspective can be structural design-related problems as in architectural issues or equipment challenges. User error is key, and systems design continually looks for ways to prevent

the user from inadvertently making mistakes. Design of medication administration systems using electronic dispensing and bar coding have been two attempts to limit the risk for error. Systems challenges were found to be an important factor in medication errors in an observational study by Elganzouri, Standish and Androwich (2009). As long as nurses are frustrated by the systems, they will continue to seek "work-around" solutions as part of their cognitive appraisal of the system and effort to get the work done.

Cognitive or awareness issues are part of the human factors aspect of errors in health care. The researchers at the World Health Organization (WHO; 2009) are using the concept of "situation awareness" and the discussion of "mental models" to assist with decision making and to better understand how they are built into human fallibility as a precursor to errors. Situation awareness is a term for attention or perception of surroundings and activities. It involves understanding the current situation, the meaning of the events occurring, and being able to predict potential future events. Simpson and Knox (2003) cited mental slips/trip/lapses and normalization of deviance as cause for error and called for meticulous situational awareness, superb communication, and high-reliability teamwork. There have been several tools developed in other disciplines to measure situation awareness, including the Situation Awareness Global Assessment Technique (SAGAT) used by the airline industry (Bolstad, Cuevas, Costello, & Rousey, 2005). The WHO (2009) called for more research in the medical field to better understand how human factors contribute to errors.

Conceptual Clarity

The conceptual framework for this study is the Delphi Technique itself. The Rand Corporation developed the Delphi Study in the early 1950's as an interactive way to

garner the opinions of experts to try to avert military or nuclear missile attack (Yang, 2003). Martino (1993) conducted over 40 reviews of Delphi studies and suggested that although there are few hard rules for administering this type of study, it typically has three features: iteration with controlled feedback, anonymity, and a statistical representation of group responses for reporting purposes. The specificity of the initial questioning varies between studies. Some researchers ask only for an initial list of thoughts, others proceed with an initial set of questions. Either method is acceptable (Mannix, 2011).

Conceptual definitions of key words promote understanding of the researcher's view of each term. One of the outcomes of a Delphi Study is continuing clarification of the phenomena of study. Since the Delphi method promotes the identification of concepts as it progresses, there are few *a priori* concepts. However, some conceptual definitions will aid in understanding of the process of exploring human factors in nursing errors.

Human Factors

The International Ergonomics Association (as cited in Human Ergonomics Society, 2000) defines human factors (which is also termed ergonomics) as the "scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance" (para. 1). Eliminating human factor failures may be very difficult or even impossible, but processes may be put into place to mitigate their effect.

Nursing Errors

Errors are planned activities that fail to achieve their goal, when such failures are not due to chance alone (Reason, 1990). Medical errors are those errors that occur in the healthcare setting during the process of delivering care (Grober & Bohnen, 2005). Although nurses are traditionally at the sharp end, or the final step in the error process, all members of the team contribute to the error process.

Research Design and Methods

Research Question

The following research question guided the Delphi Study: what are the human factors that contribute to nursing errors? Hospital nurses spend the majority of their time in interaction with patients. They are involved in the most intricate processes of patient care, yet the nursing shortage and basic economics have resulted in an environment where nurses receive increasingly heavy assignments and contend with a growing complexity of electronic tools and media. In addition to a conscious effort to provide safe and optimal care, nurses who have committed an error carry the burden of guilt and self-recrimination associated with the real or imagined risk to the patient (Arndt, 1994; Johnson, Tran, Thuy, & Young, 2011). Understanding how human factors contribute to error occurrence may support ongoing change in the approach from *post hoc* finger-pointing and blame to an *a priori* approach of error mitigation in the future.

Investigating this research question promoted understanding regarding the reasons for errors instead of just quantifying or trying to assign blame or responsibility for the errors; the end result is a snapshot of the nurse error trajectory. The iterative

process of a Delphi study allowed the expert panel to confirm or react to items found early in the process.

Design

A two-stage Delphi Technique inquiry method was used to gather input. Using the typical iterative Delphi study format, this study used feedback from a panel of nurse experts on an initial survey qualitative question followed by synthesis of the results with feedback and confirmation. These synthesized themes were then incorporated into a quantitative Likert-type Scale, and the original expert panel participants were queried a second time to validate responses.

Round 1 of the Delphi consisted of the initial question posed in an online survey format. The question asked the expert panel (n=25) to consider and list as many causes of errors as possible in an open-ended, free-flowing way. The initial survey responses were aggregated into discrete phrases or themes by the researcher. In Round 2 of the Delphi, a second survey was sent to the same panel of experts (n=24) asking them to rate each identified item on a Likert scale indicating strength of likelihood to be a cause of nursing errors. As a result, a consensus among the expert panel regarding the level of importance for each item was reached.

Rationale

An on-line sequential Delphi Survey design was used to conduct the study. Keeney, Hasson, and McKenna (2000) described the Delphi technique as an iterative multi-stage process designed to transform personal opinion into group consensus. This research methodology allows interaction amongst nurses who are experts in nursing errors, either through evaluation of events or through personal experience. McKenna

(1994) described the Delphi study as quasi-anonymous, because anonymity was maintained between participants but not between participant and researcher.

The Delphi technique was appropriately chosen for this study in light of its characteristics. A collection of subjective judgments was needed rather than precise data analysis such as direct observation. The number of subjects needed did not lend itself to face-to-face contact individually or by groups in light of logistics, time, or cost. Anonymity needed to be assured due to the nature of the events involved. Validity of the results is dependent upon heterogeneity of the participants, and the researcher must be assured that no one participant has undue influence over the other participants (Waltz, Strickland, & Lenz, 2010). Using an online Delphi technique satisfied the parameters of the study and allowed meaningful data to be obtained.

Methods

In the literature, there is no agreement for the panel size in a Delphi study. Use of a large panel is difficult due to the large amounts of qualitative data collected. Group size is not determined by statistical power but on group dynamics and richness of results (Keeney, Hasson & McKenna, 2006). The number of nurses included in this study's expert panel was larger than is common to most Delphi studies (Bäck-Pettersson, Hermansson, Sernert, & Björkelund, 2008; Harper, Asselin, Kurtz, Macarthur, & Perron, 2012; Wilson, Ramelet, & Zuiderduyn, 2010). However, the number was believed to be important to getting a wide breadth of input from persons with different levels of patient safety involvement. For this reason, both highly-educated, quality experts and staff nurses who experience the challenges of maintaining an error-free environment every day were included.

The primary issue with selection of participants in this study was the term "experts", traditionally chosen for the initial study phase of a Delphi survey. Experts in nursing errors might be Safety Nurses, Quality Assurance nurses, or Risk Managers. They could also be nurses who are involved in direct patient care. Preconceived notions that Quality Assurance or Risk Management teams may have regarding the causes of nursing errors might skew answers in the first round of surveys. Nurses who provide patient care can draw only on their own experiences, or the experiences of their peers, potentially narrowing their possible responses. Utilization of both groups as experts was believed to offer some control for these factors. Ludwig (1997) reports that the number of experts used in a Delphi study is usually determined by the number required to provide a representative sample of opinions and the amount of information the researcher is able to process. In order to best manage both factors, a convenience sample of eighteen Safety Nurses, Quality Assurance Nurses, or Risk Managers in two hospital systems, plus twelve randomly selected nurses in one hospital system were initially queried for a total of thirty nurses. Four Quality Assurance Nurses and one randomly chosen nurse declined to participate for a total sample size of 25.

The second round survey was completed by the same group of experts; one nurse declined subsequent participation. The experts were given two weeks to respond to each survey, and a reminder email was sent after one week to those who had not responded.

Inclusion Criteria

Inclusion criteria was having RN licensure and being employed by the participating hospitals as a staff nurse or in one of the patient safety support departments. Eighteen of the individuals in the expert group were chosen for their work in Quality

Assurance, Safety, or Risk Management, and from two different hospital systems in two different states to provide diversity. Volunteers for the expert group were recruited from the hospital staff in one system. There were fifty-two volunteers, and twelve of those were randomly chosen to participate.

Data Collection

The initial email survey (Appendix A) queried demographic information and an open-ended question: *Please tell me all of the things you can think of that might contribute to a medical error. List as many as you wish. Please take your time to think about these answers, and think beyond the surface issues. For example, instead of listing "fatigue", indicate "the nurse just worked her third 12 hour shift in a row and cannot keep her concentration", or "the nurse was unable to sleep prior to coming onto a night shift, and cannot focus."* A definition of nursing error and human factors was included for clarity. In addition, two questions regarding medication errors were included that asked if respondents had ever made a medication error, and if they had ever made a medication error they had not reported. Respondents were given the option not to answer these two questions, although all participants did answer both questions.

With the online open-question format, respondents were given the ability to respond freely with their own words and from their own perspective (Portney & Watkins, 2009). No answers required clarification from the participants. The participants provided 249 reasons that nursing errors might occur. The list of reasons identified by the first survey was analyzed using a linguistic analysis method in which participants' words are studied and evaluated for common meanings (Hanauer, Frederick. Fotinakes, & Stroble, 2012) and then collapsed to get a discrete list of answers. These answers were

analyzed, grouped into like responses with duplicates eliminated, and the resulting 28 reasons were listed in a random order for the second survey. To increase confidence in the linguistic analysis of the data, a means of inter-rater reliability was established. A masters-prepared, doctoral candidate nurse colleague conducted an independent, concurrent thematic analysis of the input. The goal of this confirmatory analysis was to ensure consistent theme identification, fidelity in collapsing themes, and inclusion of all ideas expressed. These analyses were compared and combined to establish validity of the themes used through a consensus process which eventually became the 28 items used for the feedback survey.

The second survey (Appendix B) utilized a Likert Scale, from 1-10, where 1 was "not important at all" up to 10, which was "extremely important" for each of the 28 items. This allowed the expert panel to clarify how much weight they attributed to each of the thematic items. These results were coded, and items were evaluated using a Diagnostic Content Validation (DCV) methodology to determine which met the threshold for retention.

Differentiation between non-essential, minor, and major human factors in nursing errors was determined using the DCV score model (Fehring, 1987; Wieck, 1996). A DCV score was calculated by using the mean score for each survey item and dividing by 10, making each score less than 1.0 for a weighted mean. The Fehring (1987) method was utilized to evaluate efficiency of each item. Items scoring below 0.600 were discarded, those with scores between 0.600 and 0.800 were considered weak factors, and those with scores above 0.800 were considered significant or major factors.

One concern in Delphi studies is the drop-out rate, or non-responsiveness rate, of participants. A response rate of at least 50% of the nurses who received the initial survey invitation is the general requirement to minimize the threat to external validity (Fowler, 2001). The actual response rate for Round 1 was 83% with a retention rate for Round 2 of 96%. Inclusion in the first round was encouraged by validation of the reason the individual was chosen as an expert in this content area, and reminder emails were sent for those who had not responded. Inclusion in the second round was encouraged by using a survey tool that takes a limited time frame to complete and reminder emails sent after one week and two weeks to participants who had not responded by completing the survey.

Results

Descriptive statistics were gathered for all participants and evaluated for percentage, mean, and range as appropriate (Table 1). The mean age of the expert panel nurses was 52.3, and their mean years of nursing was 23.7. The demographics reflect an older, more experienced group as the panel was skewed toward nurses who work in Quality Assurance, Risk Management and Patient Safety departments. These roles are generally filled by nurses with more years of experience and higher degrees of education. Of interest were the answers to the questions regarding medication errors. Of those in the expert panel group who acknowledged making an error, 27% admitted to having made an unreported error.

In the second phase, a DCV score was calculated for each item based on the mean. Three items with a DCV score less than 0.600 were eliminated (Table 2). The three eliminated items were “non-clinical demands (concerns re: Hospital Consumer Assessment of Healthcare Provider [HCAPS] scores, Surgical Care Improvement Project

[SCIP] measures, patient satisfaction)", "a problem with required documentation", and "a problem with work space design, environment, or noise". Respondents felt that "lack of nursing competency or knowledge regarding a patient condition or medication" was encompassed by "nurse is placed in an unfamiliar circumstance (patient type or unit type)" and "lack of critical thinking," so it was also eliminated.

In general, the likely causes of medical errors in hospitals fell into three areas: 1) the biophysical state of the individual nurse; 2) the environment of the clinical unit; and 3) tolerated general risk situations (Table 3). The biophysical state of the individual nurse appears to be most frequent (n=11 items) and included errors relating to fatigue and physical impairment. These errors are considered amenable to nurse-initiated solutions. The second most common cause (n=7) was the environmental state of the clinical unit itself and included items such as work too fast paced and distraction due to phone calls. Lastly, the risk situations involved in daily nursing activities (n=6) included communication problems, ineffective policies and procedures, and technology problems. These general areas of causation seem to point to a complex multifaceted problem of hospital errors which needs further clarity to arrive at solutions.

Study Strengths and Limitations

While there has been an increased focus on preventing errors in the healthcare setting, actions taken to make system corrections have not eliminated errors. A better understanding of the human factors that contribute to nursing errors is timely and may promote research that improves patient safety.

Strengths of the study involved the Delphi design, confirmatory measures, and an inclusive expert panel. The sequential transformative strategy of this Delphi study lends

itself to give voice to diverse perspectives of the experts involved. This promotes understanding of the phenomenon being studied. Inter-rater reliability through consensus in the process of collapsing the initial Round 1 input increased confidence in the portrayal of expert input. The utilization of a Delphi methodology allows a broad representation of survey results giving a richer and more detailed understanding of human factors involved in nursing errors. There is a potential loss of individual responses of the participants in the greater conclusion because of the need for a second contribution to findings. This can result in loss of subjects; however, only one person chose not to continue the study in Round 2, resulting in a strong basis for conclusions.

Study limitations include a potential for lost factors. Even though individual responses may show some very clear insights into the reasons for nursing errors, if the theme is not repeated by several of the experts, this element may be eliminated from further evaluation. There is a risk that new ideas which are out of the mainstream may be lost due to the need for corroboration by other panelists. These are elements over which the researcher has little control but may have an effect on the outcomes.

In addition, the use of administrative (quality assurance, risk management, patient safety) nurses in the field may lend itself to having a skewed representation of nurses with higher levels of education or advanced age. These data were examined using descriptive statistics, and the staff nurse group was underrepresented. The mean age of the administrative nurse group was 54.7, while the staff nurse group was 47.9. Mean years of practice was 29.0 for the administrative nurse group and 16.2 for the staff nurse group. Education level differed only slightly, with the administrative group having several PhD/DNP prepared nurses.

As always, there is a possibility that the researcher's point of view influenced the evaluation of the initial question and categorization of answers. Use of another nurse to provide a means of inter-rater reliability helped to ameliorate this potential problem to some degree. The support of the dissertation chair and subsequent committee input to validate conclusions also helped to prevent bias.

Summary

The Delphi Method is an excellent approach to discovery. Although many studies of incidence, causes, and outcomes of errors in hospitals have been reported, the problem of errors remains. This study relied on a group of expert nurses to provide their ideas about which factors were important from the nurses' viewpoint. The list of 24 items provides a basis for further assessment of possible mitigation strategies for nursing errors in hospitals.

Understanding the human factors that contribute to nursing errors may improve patient safety, contribute to research in human factors, and increase how nurses perceive their involvement in hospital errors. The use of the Delphi Survey created consensus and developed a platform upon which future study can evolve. Every error carries inherent risk for both the patient and the nurse. Actions to identify how nurses believe about what causes errors is a big step toward the goal of an error-free culture of safety in the nation's hospitals.

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Table 1. Expert Panel Demographics

Survey 1		N = 25	%
Gender	Male	1	4
	Female	24	96
Race	Asian/Pacific Islander	0	0
	Hispanic/Latino	0	0
	Black/African American	2	8
	Caucasian/NonHispanic	21	88
	American Indian	1	4
	Other/Mixed	0	0
	Prefer Not To Answer	0	0
Highest Degree Obtained	Diploma Degree	0	0
	Associates Degree	0	0
	Baccalaureate Degree	9	38
	Masters Degree	12	50
	PhD/DNP Degree	3	13
Shift	Days	22	92
	Nights	2	8
Area Most Worked	Administration	4	16
	ER	0	0
	ICU	5	21
	Med/Surg	3	12
	Surgery/PACU	2	8
	OB	2	8
	Pediatrics	0	0
	Quality/Risk Management	7	30
Ever made nursing error?	Yes	18	72
	No	3	12
Made error but did not report?	Yes	8	28
	No	16	64

Table 2. Likelihood Scores in Causes of Medical Errors in Hospitals – Delphi Round 2 Results

	DCV
Fatigue from lack of sleep	.83
Fatigue from too many hours worked	.89
Swamping too heavy work load	.89
Work too fast paced	.83
Non-clinical demands	.54*
Lack of nursing competency or knowledge	.81*
Horizontal/Lateral violence	.70
Unfamiliar circumstance	.77
Apathetic or doesn't care about the work	.78
Distraction from a phone call	.68
Distraction causing loss of focus	.69
Inattentional blindness	.80
Language barrier	.64
Nurse feeling ill but still working	.70
Nurse impaired by a substance	.80
Problem with technology	.70
Lack of resources	.74
Problem with required documentation	.56*
Problem with work space design, environment, or noise	.60*
Errors made by others nurses are expected to fix	.72
Tasks done automatically or by rote	.72
Lack of critical thinking	.82
Nurse acting beyond the legal scope of practice	.67
Lack of team work	.71
A problem with communication, written or verbal	.85
A problem with workplace satisfaction	.60
A poor work culture	.70
Ineffective or incorrect policies and procedures	.67

*Item deleted from Hospital=Based Nurse Survey

Table 3. General Topics of Likelihood to Cause Nursing Errors in Hospitals

Items	General Topic*
Fatigue from lack of sleep	1
Fatigue from too many hours worked	1
Swamping too heavy work load	2
Work too fast paced	2
Non-clinical demands	X
Lack of nursing competency or knowledge	X
Horizontal/Lateral violence	2
Unfamiliar circumstance	1
Apathetic or doesn't care about the work	1
Distraction from a phone call	2
Distraction causing loss of focus	2
Inattentional blindness	2
Language barrier	1
Nurse feeling ill but still working	1
Nurse impaired by a substance	1
Problem with technology	3
Lack of resources	3
Problem with required documentation	X
Problem with work space design, environment, or noise	X
Errors made by others nurses are expected to fix	1
Tasks done automatically or by rote	1
Lack of critical thinking	1
Nurse acting beyond the legal scope of practice	1
Lack of team work	2
A problem with communication, written or verbal	3
A problem with workplace satisfaction	3
A poor work culture	3
Ineffective or incorrect policies and procedures	3

*1. Nurse's biophysical state (tired)
2. Unit's environmental state (busy)
3. Tolerated general risk situation (bad policy)

Chapter 3. Hospital Nurses' Perceptions of Human Factors Contributing to Nursing Errors

Abstract

Patient safety in hospitals has been a major focus in healthcare for the past 15 years. While some improvement has been made, errors still occur at an alarming rate. Understanding the human factors associated with hospital errors will help to provide a framework to promote a multilevel and interdisciplinary discussion about why these errors occur. This study of 393 hospital-based registered nurses explored the perceptions of likelihood, intervenability, importance, and commonness of 24 previously-identified items relating to human errors in hospitals. The top ten responses identified by nurses are reported for each of the four aspects of human errors. Factor analysis of responses regarding how likely a factor was to contribute to a nursing error was done. The resulting data revealed four themes: loss of focus, unhealthy environment, interpersonal deficits, and overwhelmed.

Keywords: Human factors, nursing errors, hospital nurses, error prevention

Hospital Nurses' Perceptions of Human Factors Contributing to Nursing Errors

Patient safety is one of the keystones of nursing. A renewed emphasis on patient safety began with the Institute of Medicine (IOM) report, "To Err Is Human" (Kohn, Corrigan, and Donaldson, 2000). Even with focus on strategies to reduce errors, an estimated 1.5 million patients are injured each year in the United States (IOM, 2006). Nurses at the bedside are often involved in identifying, remediating, and sometimes contributing to nursing errors. Understanding the involvement of human factors in errors may promote improvement in the delivery of nursing care and lead to safer nursing interventions. This study will provide a theoretical contribution to nursing literature by identifying how staff nurses view specific human factors related to the likelihood, intervenability, importance, and commonness of factors contributing to nursing errors. It will fill a gap in the literature regarding nurse perceptions of their own ability to influence a safer patient environment and may propel research toward solutions to the problem of nursing errors.

Purpose of the Research Study

The purpose of this study is twofold: (a) identify themes relating to human factors that affect nursing errors; and (b) identify nurses' perceptions of likelihood to cause errors, as well as the ability to intervene, importance, and commonness relating to human factors causing errors. The perceptions of nurses can contribute to solutions and acceptance of new strategies to control and mitigate human errors in hospitals.

The goal of this study is to provide a framework for planning strategies aimed at mitigating the recurrence of errors in the delivery of nursing care. Nurses understand that

human factors contribute to nursing errors, but it is unclear if nurses agree on which factors are most likely to cause errors, which errors are most important, what can be done to intervene to reduce or eliminate errors, and even how commonly errors occur. Understanding the degree of agreement or discordance will help identify what kinds of education, remediation, or oversight might be needed to decrease errors. Getting the nursing perspective will help hospital managers, quality control professionals, patient safety officers, and nurses themselves to understand how to control for these innate human cognitive processing constraints in order to improve the safe delivery of nursing care. Human fallibility and system fallibility have been the subject of an abundance of research and development, yet nursing errors continue to occur. Exploring human factors and designing nursing practice around controls for human processing failures may assist in providing a higher level of patient safety.

Literature Support for Addressing Nursing Errors

Human fallibility and system fallibility are both responsible for the errors in health systems today. Human fallibility relates to the basic human frailty of all people. Errors are part of the human experience for many reasons and often are not controllable. The system fallibility issues that are part of the overall human factors perspective can be structural design-related problems as in architectural issues, or equipment challenges. User error is key, and systems design continually looks for ways to prevent the users from inadvertently making mistakes. Improving understanding of how human factors can be controlled in systems designs may lead to improved care delivery.

Human Fallibility

Despite the public expectation of perfectionism on the part of health professionals, the fact remains that every healthcare provider is human and subject to basic human fallibility. Attempts to control for the human factors involved in errors begin with measures as simple as policies and procedures. By setting the standard for actions that should be taken in a given circumstance, expectations for correct behavior are determined. Becoming familiar with the hospital's policies and procedures is part of every nurse's orientation. From the early days in their employment, nurses are responsible to know hospital rules and to follow them to the smallest detail. Hospitals are required to update their policies at least every three years by regulatory agencies such as The Joint Commission on the Accreditation of Health Organizations (JCAHO). Nurses must be able to access these policies and procedures when questions arise or when they are unsure of the requirements. Yet failure to follow hospital policies and procedures continues to result in medication errors (Hughes & Blegen, 2008, Leape et al., 1995).

Human factors have been blamed for medication administration errors in several studies. The IOM's report "Preventing Medication Errors" (2006) called for the Agency for Healthcare Research and Quality (AHRQ) to consider human factors when evaluating safety alert mechanisms. Human factors have been shown to be a main cause of errors in a patient-controlled analgesia (PCA) study of 624 harmful incidents (Hicks, Sikirica, Nelson, Schein, & Cousins, 2008). Holden, et al. (2011) found that mental workload issues such as interruptions, divided attention, and being rushed were significantly associated with medication error likelihood (path loading = 1.04) and called for increased study of human factors.

Distraction and interruption have been studied as human factors contributing to nursing errors (Bennett, Dawoud, & Maben, 2010). Biron, Loiselle, and Lavoie-Tremblay (2009) found an average of 6.7 work interruptions per hour during medication administration. In an observation of 945 drugs administered, Palese, Sartor, Costaperaria, and Bresadola (2009) found one interruption for every 3.2 drugs given. In a study involving 4,271 separate medication administration events, Westbrook, Woods, Rob, Dunsmuir and Day (2010) found a 12.1% increase in procedural failures and a 12.7% increase in clinical errors per interruption. The same study also noted that error severity increased with interruption frequency. The Institute of Safe Medicine Practices (ISMP) recommends a visual "Do Not Disturb" sign in the form of a colored vest or sash to minimize interruptions (ISMP, 2012). A state-of-the-science paper reviewing 31 articles concluded that beliefs about the link between interruptions and medication error were based more on conjecture than evidence and called for more research in this area (Hopkinson & Mowinski-Jennings, 2013), similar to the work that has been done on the link between fatigue and errors.

Acute and long term fatigue are human factors that have been studied as individual issues. Acute fatigue was described by Brake and Bates (2001) as mental fatigue due to mental overload or underload or physical fatigue. Long-term or prolonged fatigue was termed as that fatigue which is irreversible and no longer responsive to compensatory mechanisms (Wadsworth, Allen, Wellens, McNamara, & Smith, 2006). Nurses suffer from both acute and long-term fatigue. Reports on fatigue have mixed results. One study found that staff nurses who work shifts greater than 12.5 hours make twice as many medical errors (OR = 1.94, p = .03) as those working shorter shifts (Scott,

Rogers, Hwang & Zhang, 2006). Bellebaum (2008) observed 548 medication administrations and found no correlation between errors and 12 hour shifts worked or reported fatigue.

Medication errors in nursing arise from a complex distribution system which is fraught with opportunities for human input increasing the risk for errors. A glimpse of human factor implications in other types of hospital errors not involving medication might offer some insight into why nurses make medication errors. Other human factors have been studied in relation to errors, such as attentional blink (Raymond, Shapiro, & Arnell, 1992), inattentional blindness (Rock, Linnett, Grant, & Mack, 1992), swamping (Crawford, 2004), and normalization of deviance (King, 2010). Lum, Fairbanks, Pennington, and Zwemer (2005) described an incident where a guide wire was left in a patient following femoral line placement. Multiple chest x-rays, an echocardiogram, and a CT scan were obtained over the next several days. These studies were read by multiple providers, and no one reported the clearly visible guide wire. In the discussion following the incident, authors mention inattentional blindness, or failure to notice something significant because of focus in another area, as one explanation for the error. Simpson and Knox (2003) reviewed causes of adverse perinatal outcomes, citing slips/trip/lapses and normalization of deviance; they called for diligence in situational awareness, superb communication, and high-reliability teamwork. The surgical nursing literature has recently begun to look at human factors as they contribute to errors in the operating room amid growing calls for more work and training in this field (Elbardissi & Stundt, 2012; Parker, Schnell & White, 2009). Human factors are capricious, difficult to anticipate and

control; however, when the human factors are compounded by failures in the support system for medication administration, the potential for error escalates.

System Fallibility

Despite the best efforts to safeguard processes and equipment, systems fail. The redesign of systems has been the focus of safeguards against human fallibility, but the systems have an inherent fallibility factor themselves. Rogerson and Tremethick (2004) called for equipment standardization as a key systems approach to reduce medical errors in the Intensive Care areas. Systems challenges were found to be a contributing factor in medication errors in an observational study by Elganzouri, Standish and Androwich (2009).

In an effort to enhance patient safety, JCAHO released the National Patient Safety Goals in 2002 (JCAHO, 2013). The Joint Commission began to require that hospitals report Sentinel Events in 1998, and they redefined Sentinel Event in 2007 as "an unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof" (JCAHO, 2012, para. 2). These requirements are meant to put system processes into place that will prevent errors.

Systems errors may also occur due to the structural environment. Architectural and equipment challenges may contribute to errors. Soares, et al. (2012) and Pennathur, et al. (2013) reported on measures to accommodate human factors in the operating room that included equipment and room design. The use of a "No Interruption Zone" marked by simple duct tape on the floor successfully resulted in a 40.9% decrease in medication errors (Anthony, Wiencek, Bauer, Dalym & Anthony, 2010). It is clear that many

system-based strategies to prevent errors do not have to be cost-prohibitive or time-consuming.

System errors may also occur as part of the medication delivery process itself. The actual error rate may remain unknown due to the inability to capture true data. Nurses may not report errors due to a variety of reasons, including reporter burden, professional identity, information gap, organizational factors and fear (Hartnell, MacKinnon, Sketris, & Fleming, 2012). However, bringing systems-based errors out in the open is vital to finding solutions. A culture of no-fault error reporting should be encouraged (Carlton, 2007), which includes sharing of near misses, trigger patterns, and multidisciplinary team cooperation and problem solving.

Nursing Errors in Care Delivery

The researchers at the ISMP (2009) addressed nursing errors in care delivery. They stated "efforts should center on increasing conspicuity of critical information, and decreasing diversions of attention and secondary tasks when carrying out complex tasks" (para. 18). Brady, Malone, and Fleming (2009) determined through a systematic review of the literature that problems, including medical reconciliation, type of drug distribution system, quality of prescriptions, deviations from procedures, nurses' knowledge of medicine and mathematical skills, and fear of reporting were significant contributors to the incidence of nursing errors. Only a very limited mention of human factors was made. Conrad, Fields, McNamara, Cone, and Atkins (2010) published an article demonstrating that distractions were a cause of medical errors in the Emergency Room. A significant difference was found in attention for night shift nurses versus day shift and evening shift nurses, with night shift nurses having lower attention scores (Niu et al., 2012).

Previous examinations of nursing errors have given rise to several common themes: acknowledging one's fallibility (Coli, dos Anjos, & Pereira, 2010), acknowledging and reporting errors (Fry & Dacey, 2007; Johnson, Tran, Thuy, & Young, 2011), and hiding errors (Unver, Tastan, & Akbayrak, 2012). Investigators examined the nurses' reports with a bioethics lens and found that nurses felt that when acknowledging errors they must realize they are in a vulnerable state, be willing to face ethical considerations, and consider the whole of the context in the final analysis (Coli, dos Anjos, & Pereira).

When looking into the causes of nursing errors, Gibson (2001) felt that nurses' experiences and knowledge regarding errors were under-valued and recommended that more research be done in this area. Chipps, et al., (2011) concurred that nurses should be at the front line of research regarding errors and patient safety. Globally, nurses are on that front line to identify, interrupt, and correct nursing errors and to minimize preventable errors (Henneman et al, 2010). Using surveys and focus groups of critical care nurses, Elder, Brungs, Nagy, Kudel, and Render (2008) found that only rarely were nurses asked for feedback following an error.

Health institutions need to have a culture of transparency related to errors (Santos, Silva, Munari & Miasso, 2010). Nurses should be integral to the team evaluating the error and should take the lead in investigations and subsequent implementation of lessons learned. Nursing presence is required by the Joint Commission when doing "Root Cause Analysis" on all sentinel events (JCAHO, 2012).

Interpretation and synthesis of the major themes of human factors contributing to errors made by nursing will contribute to the clarification of needed research to provide

solutions. It is evident that the prevention of errors in hospitals is a complex problem which begs for solutions.

Theoretical Framework

The Global Workspace Theory (GWT) relates to attention and awareness in the work setting (Baars, 1988). The premise of GWT is that conscious (cognitive) content includes attention, memory, evaluation, and verbal response. This content is used in decision making and action selection. The GWT demonstrates a theoretical mapping framework of the brain neuropathways in which independent processes are linked to a central area of consciousness (Figure 1). This mapping creates pathways in the brain that are available in the future should a similar encounter occur. When that pathway is interrupted by another thought pattern, it may cause a stop and deviation in the pathway of the original thought. The model theorizes that changes in the neuronal patterns are generated with new patterns of thought which may or may not stimulate new pathways. One way to think about the GWT is to compare it to a stage play. The action occurring in the spotlight remains the focus of the audience, while many other processes that support the production are occurring in the background. Those background actions have a profound impact on the central scene, but the audience is unaware. An error in the background scene may have a substantial impact on the main area of focus, and adjustments must be made quickly, which are often unnoticed by the audience themselves. So it is with the global workspace in the brain. The central area of focus can be changed significantly by diversions in the background activities of the thought process or deviations in the neuronal pathways, even without conscious awareness.

The GWT gives nurses a physiological prism through which to view one aspect of awareness and focus. The model shows the complicated interplay of the neuronal pathways in the brain as related to the patterns of attentiveness. Mapping these brain processes can determine the impact of specific actions or events on consciousness and attention. When deciding what should be the primary target of focus, nurses must eliminate other distractors and filter out irrelevant input in order to maintain the necessary neuronal pathway, sometimes referred to as train of thought. Nurses can then move toward additional clarity by adding the emotional, mental, and psycho-social mediators to attentiveness while attending to qualifying neuronal pathway messages which may or may not be amenable to nursing interventions. While focusing on their primary target of thought, there may be new ways nurses can maintain focus through nursing interventions aimed at enhancing concentration. An example might include bedside medication dispensing, where medications are delivered from the pharmacy directly to a bedside station for each patient, eliminating many of the possible distractions at the nurses' station and pathway to the patient's room. The ability of the nurse to maintain focus without deviating to other neuronal pathways may contribute to positive outcomes for the patient. The GWT should lead nursing leaders to think about how the nursing plan of care and implementation might be impacted by the way nurses must constantly process information.

Reasons' Theory of Human Error (2000) and the resulting Swiss Cheese Model (Figure 2) demonstrates how a multi-layer set of events might produce an error. Each layer of the model has holes, representing events, through which an error might pass. Should an error get through each layer of prevention, the error may reach the patient.

Utilizing this model, healthcare organizations began to see prevention of system failures as the key to patient safety. While this model may explain the system processes which repeatedly fail, it does not delve deeper into the human reasons related to the events and whether they are likely to cause error, or are intervenable, important, or common.

In 2011, Baron introduced the Human Factors Funnel Model (Figure 3), which was developed in the aviation industry as a conceptual framework that illustrated the many component parts throughout an organization that can impact error causation and accidents. He purports that errors funnel through the atmosphere (setting), the attributes, attitudes, decisions, and actions of the persons involved, and eventually produce the outcome, which may include error. This model is applicable to nursing, as it relates to how the hospital setting and the personal traits of the nurse involved contribute to the outcome.

While each of these models provides a glimpse at one aspect of nursing errors in the hospital setting, none of them is comprehensive enough to describe the complexity of the nexus of errors in health care settings. One discussion which is missing is an examination of the factors perceived likely to cause errors, intervenability potential for different types of mistakes, the importance nurses attribute to each type of error, and the commonness of error occurrence. Understanding these aspects will lead to a more complete understanding of the connections, priorities, and possibilities for change. For this reason, no specific model was used to guide this research because the goal is to provide the basis for a beginning framework based on the data collected.

Conceptual and Operational Definitions of Key Concepts

Four key concepts are integral to the analysis of nurses' perceptions of human factors contributing to nursing errors. They are likelihood, intervenability, importance and commonness. Human factors is also defined for clarity. Conceptual and operational definitions are found in Table 1.

Research Design and Methods

Research Questions

The following research questions were asked:

1. What are nursing beliefs about the likelihood, ability to intervene, importance, and commonness of nursing errors?
2. What is the relationship of demographics to the identified human factors in nursing errors?

Investigating these research questions provides enlightenment in the factors leading to nursing errors. A better understanding of these factors should provide a foundation on which to propel changes that will decrease errors and improve patient safety.

This study was approved as a subset of a Delphi study by the University of Texas at Tyler Institutional Research Board and the hospital Institutional Research Board. A consent statement was included in the introduction to the survey, and consent was implied by participation and submission of data.

Design

A cross-sectional descriptive design was used to gather data from a large group of nurses in a southwestern hospital system. The online survey allowed confirmation of

themes identified as important in relation to human factors related to nurse errors. A single data-collection period provided input for a factor analysis of data relating to nurses' perceptions of the likelihood of 24 items being present in a nursing error situation. In addition, priority rankings were determined on what nurses perceived as most likely to cause errors, most intervenable, most important, and most common causes of errors in hospitals.

Sample

The available population was all registered nurses in a large community three-hospital system with Magnet designation (American Nurse Credentialing Center, 2013). The use of a single hospital system is warranted in order to optimize confidence that nurses will be forthcoming about nursing errors and to ensure that the context was similar for all subjects. Approximately 1,808 RNs work in this hospital system. The number of nurses who participated was 393 for an approximate response rate of 21.74%. Magnet hospitals are noted for their superior dedication to nurse autonomy. Nurses who work in Magnet hospitals enjoy a confidence that error reporting will be connected to a solutions-based approach rather than a punitive process. Removing the punitive aspect of nursing error management should mean that nurses feel free to be honest and forthcoming about the items asked on the survey. The nurses were invited to participate through an introductory email (Appendix C) with an intranet link to an anonymous online survey (Appendix D). The survey contained information about the study details, and consent to participate was implied by survey completion. Identity of participants was not known; a separate link was available for participants to register for the opportunity to receive an incentive at the end of the study. Hospital system administrators did not have access to

the list of participants who registered at the incentive link. The only inclusion criterion was employment at the hospital system as a registered nurse.

Procedures

Data Collection

Data were obtained via an online survey platform called Qualtrics (2014). Qualtrics provides a format guide for the survey, the link for the anonymous survey, and basic evaluation of resulting data, including mean and range.

Nurses were asked to respond to a survey by answering four questions about each of 24 items identified as likely to cause nursing errors on a previous Delphi study. Response was provided using a 10-point visual analogue scale. The four questions were:

1. How likely is this item to contribute to nursing errors (highly likely to not likely at all)?
2. How would you rate your ability to intervene in this factor (highly able to intervene to not able to intervene at all)?
3. How important is this item as a possible cause of nursing errors (highly important to not important at all)?
4. How common is this factor in your hospital (highly common to not common at all)?

Participation was encouraged by using a survey tool that takes a limited time frame to complete and reminder emails sent after one week and two weeks. A drawing for an electronic tablet was offered, and one participant was chosen to receive the tablet after data collection was completed.

Findings

Research Questions

Two research questions drove this study. The first question explored nursing beliefs about the likelihood, ability to intervene, importance, and commonness of nursing errors. To answer this question, four scales based on the 24 previously identified factors related to human factors in nursing errors were used (Table 3). A visual analogue scale of one to ten was used to allow nurses to report the strength of their perceptions. One scale was generated from responses to the question of the likelihood of the factor to cause a nursing error. A scale also asked how much ability the nurse felt there was to intervene or change the factor (Intervenability Scale). The next scale asked the nurses to rate each of the 24 factors based on how important the factor was in the occurrence of errors (Importance Scale). The final scale asked how common the factor was (Commonness Scale). The Likelihood Scale was used in a factor analysis to determine major themes relating to likely causes of nursing errors (Table 4). Data originated from a Delphi study which asked what causes nursing errors; therefore, the factor analysis was an attempt to distill the responses into a tight framework that might provide a lens through which to view strategies that might mitigate or decrease the potential likelihood of nursing errors.

The second question examined the relationship of demographics to the identified factors. The demographics were examined for descriptives and frequencies. Three demographic characteristics (shift worked, education level, and prior medication error) were used as grouping variables and analyzed using the summed scores of the four factors (i.e. Loss of Focus, Unhealthy Environment, Interpersonal Deficits, and Overwhelmed) for analysis of differences (Table 5).

Likelihood scale. The factor identified by the nurses as most likely to cause an error (Table 3) was *a nurse impaired by a substance* (*M* = 9.13). However, it was not viewed as a common problem and did not make it into the top ten on the Commonness Scale. *Swamping, or too heavy workload* (*M* = 8.90), was the second most likely cause of error, and is listed as the number one most important and most common reasons for errors. The third most common likelihood was *a problem with communication* (*M* = 8.90) which rated third or fourth on all scales. *A lack of critical thinking* (*M* = 8.56) was fourth and was also in the top ten of the Importance Scale and Most Common Scale, but was not in the top ten of the Intervenability Scale. Fifth was *errors made by others that nurses are expected to recognize and fix* (*M* = 8.55), which was in the top five on all scales. All of the top five factors had a mean above 8.0 and are considered major factors.

Intervenability scale. The highest intervenable cause of hospital errors identified by the nurses was *a nurse impaired by a substance* (*M* = 8.56). This factor is also identified as the most likely reason to cause an error, and it was listed as the second most important reason on the Importance Scale. This factor has the highest mean, as nurses working as staff are the most likely to identify the impaired nurse but may be unwilling to report their suspicions. The second most intervenable factor for nursing errors is *a nurse acting outside of the scope of practice* (*M* = 8.09); however, it was not in the top ten for likely to happen, important, or common. A *problem with communication* (*M* = 7.92) is third most frequently mentioned intervenable factor and is in the top five of all four scales. Fourth highest is *a problem with teamwork* (*M* = 7.54), which is not in the top ten of any of the other scales. *Errors made by others that nurses are expected to recognize and fix* is fifth (*M* = 7.52).

Importance scale. *Swamping or too heavy workload* is the most important factor according to nurses (*M* = 8.85). Others factors deemed important in nursing errors were *a nurse impaired by a substance* (*M* = 8.58), *errors made by others that nurses are expected to recognize and fix* (*M* = 8.49), *a problem with communication* (*M* = 8.45), and *a lack of critical thinking* (*M* = 8.23).

Commonness scale. The most common reason to cause errors was *swamping* (*M* = 7.71). The second most common reason was *work that is too fast-paced* (*M* = 6.85), which was also in the top ten most likely reasons and most important reasons, but not in the top ten of intervenable reasons to cause errors. A *problem with communication* was the third most common (*M* = 6.59), and the fourth was *fatigue from too many hours worked* (*M* = 6.37). The fifth most common was *errors made by others that nurses are expected to recognize and fix* (*M* = 6.28).

Factor analysis - likelihood scale. Responses from the hospital wide survey asking likelihood of an item causing an error were used in a factor analysis (Table 4) to determine clusters which were identified as themes. This scale was chosen because the four scales originated from a general question to nurses about what they considered to be likely causes of errors. A principal component analysis (PCA) was conducted on the 24 items with orthogonal rotation (varimax). The Kaiser-Meyer-Olkin measure verified the sampling, adequacy for the analysis, KMO = .922, and all KMO values for individual items were > .827. Bartlett's test of sphericity χ^2 (276) = 3329.49, $p < .001$, indicating that correlations between items were sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Four components had eigenvalues over Kaiser's criterion of 1 and in combination explained 55.34% of the

variance. The scree plot showed inflexions at 2 and 4. Factor analysis of the resulting data revealed four themes which were labeled: loss of focus, unhealthy environment, interpersonal deficits, and being overwhelmed.

Demographics

The sample of registered nurses who participated in this study was fairly representative of the national nursing population at large (Table 2). The average age of RNs in the US is 44.6 years (Bureau of Health Professions, 2013), and the participant population was slightly older at 46.1 years. Race differed from the general population of nurses largely due to a high rate of Caucasians, at 84%, in comparison to the average urban rate of 72.5% nationally. Only 4% were Hispanic and 1% were Black/African-American, lower than the national average of 5.4% and 10%, respectively. Nurses in this survey had a higher education level than the national average, with 75% BSN, Master's, DNP, or PhD prepared, with the national average at 64% in urban areas.

Total mean scores were studied for each of the factor analysis themes. There were no themes that were statistically different as a whole for nurses by degree achieved or as to whether they reported making an error (Table 5). The day shift nurses and night shift nurses did not score the themes significantly different for loss of focus, unhealthy environment, or interpersonal deficits. Day shift (M = 7.97, SE = 2.13) scored being overwhelmed higher than night shift (M = 7.13, SE = 2.38) and were statistically different ($t(321) = .003$, $p = < .05$). Nurses of varying educational preparation scored factors differently. Nurses with a BSN, Masters, or PhD/DNP scored all factors in the Likelihood scale higher than those with Diploma and Associate Degrees. None of these differences were statistically significant. There were 266 nurses (68%) who reported

making an error, and 69 (18%) reported they had made an error they did not report. Those who reported making an error had lower means on the importance of all factors, and higher means in intervenability in all factors, but none were significant.

Discussion and Recommendations

None of the demographic descriptors supported assumptions about differences between nurses. Day shift nurses might assume that night shift nurses get less sleep, are more fatigued, and are more prone to error. Night shift nurses have heavier patient assignments in many units. These study results showed that night nurses scored *fatigue* and *swamping* lower in likelihood to cause errors than day shift nurses. One explanation may be that night shift nurses work fatigued and with heavy workloads so often that they do not recognize the increased potential to cause error. More work should be done in this area to further understand night shift nurses' situational awareness.

As nurses gain advanced degrees, they tend to leave work at the bedside, and their views may differ as demonstrated in this survey. This area should have more research, as those with higher degrees tend to be in the more administrative roles and are making decisions about management and staffing.

Nurses who made errors may have a different view of causation because of their feelings related to their personal experience with errors. A better understanding of the views of nurses who made an error but did not report it is needed and must be done in an environment where nurses feel they can admit to this action without shame or guilt.

Factor analysis of the Likelihood to Cause a Nurse Error in the Hospital Scale identified four themes. The first theme, *loss of focus*, accounted for 38% of the variance. Nurses identified the following as common to loss of focus: *distraction due to loss of*

focus, distraction due to phone interruptions, problems with technology, nurses placed in an unfamiliar circumstance (unit type or patient type), and *inattentional blindness,* or failing to recognize an unexpected event due to focus on a primary task. Loss of focus is a very human trait. Everyone can identify with a momentary loss of the train of thought. Nurses may lose their focus when they are interrupted, an emergent event occurs, they are fatigued or have worked too many hours. It is incumbent upon nursing leaders to begin to think about ways to deliver nursing care that accounts for the causes of loss of focus. If many distractions occur at the nurses station, where the automated medication dispensing machine is located, mini-medication machines could be installed in every patient's room and stocked with only the current patient's medications. If loss of momentary focus allows nurses to forget to chart an event, systems might be put into place which involves real-time documentation by voice recognition. There are many technological advances available that could improve the nurses' ability to maintain focus, and these should be made a part of nursing care. Implementation of these tools might decrease errors and improve patient safety. Studies to test these interventions are needed.

The second theme identified was *unhealthy environment*, accounting for 7% of the variance. There are many factors that might influence the work environment, and nurses identified *dissatisfaction with the work environment, a poor work culture, ineffective or incorrect policies or procedures, a nurse who is ill but continues to work*, and a culture in which *nurse apathy* is accepted as those most likely to cause a nursing error. A workplace that makes it difficult to function produces anxiety and makes nurses vulnerable to mistakes. Nurses who burn out, or are apathetic, may no longer make an effort to implement new ideas or practice variations, especially when they feel their

workplace culture will not support change. When nurses feel impotent to make change, the workplace environment can become hostile, and nurses may leave the workplace or even the profession. These results may reflect the nurses' attitudes regarding nursing in general and should not be assumed to be specific to their institution.

Interpersonal deficits is the third theme identified, with 5% of the variance, and includes a nurse who is *working impaired by a substance, poor communication, errors others make that nurses are expected to recognize and correct,* and *lack of critical thinking*. Dealing with difficult people is endemic to a profession that deals with persons who are in high stress situations, ill, or injured. When personal deficits affect the work environment, errors can result. When any member of the healthcare team is impaired by a substance, by poor communication skills, or lack of critical thinking ability, mistakes can be the result. Poorly written and verbal communication have been indicated as causes for major error events in the literature. It is of note that hospital nurses rated *poor communication* high on the scale of likelihood to cause error (M = 8.90), ability to intervene (M = 7.94) and importance (M = 8.44), but much lower commonness (M = 6.46). Most interesting is the factor of *errors made by others that nurses must identify and correct*. Nurses often find themselves on the "sharp end" of an error (Reason, 2000). This is the end of a series of errors that occur, just as they reach the patient. Being the final safety barrier can be a heavy burden for nurses, and all members of the healthcare team should be held accountable for their part of an error event. Being held responsible for errors which others make can create a poor work culture and dissatisfaction in the workplace. A physician who refuses to enter orders correctly in the computer and expects the nurse to routinely correct the error leads to frustration and a feeling that some

parts of the error continuum cannot be fixed or changed. A focus on holding all team members accountable for their actions should be part of the future vision of nursing.

The fourth theme, accounting for 5% of the variance, is overwhelmed. Key areas likely to cause error due to being overwhelming included *fatigue, due to lack of sleep and too many hours worked*, and *swamping*. Fatigue and swamping could be related, and it is hard to determine which one leads to the other. Nurses rated *swamping* as the second highest likelihood, the most common reason and the most important reason to cause errors. It is interesting to note that swamping was not, however, in the top ten of most intervenable reasons to cause nursing errors (Table 3). As healthcare dollars tighten, nurses must increasingly deal with duties added to their daily workload which contribute to swamping. Increased documentation requirements, duties such as monitoring quality assurance for bedside lab tests, and the maintenance and checking of dietary supplies and housekeeping supplies, are routine tasks delegated to nurses. These duties divert the nurses' focus away from patient care and should be examined in light of causation of nursing errors. When increased tasks are added to nursing duties, it promotes the impression that fatigue and swamping are an unavoidable circumstance and a situation that cannot be changed. Reinforcing the perception that being overwhelmed is an unsatisfactory and remediable situation is vital to nurse retention and decrease of nursing errors.

This study has provided new areas of focus for the prevention of nursing errors through a better understanding of human factors from the perspective of nurse experts in practice and staff nurses at the bedside. Continued work to examine how to address and

intervene in these themes may improve patient care and safety, as well as job satisfaction and retention for nurses in the profession.

As nursing looks to the future, it will be important to consider how to improve care with these themes in mind. Loss of focus, an unhealthy environment, interpersonal deficits, and being overwhelmed are factors that need further study to explore possible correction actions. Nursing needs to consider new avenues of providing patient care that limit the effects of human factors on nursing errors.

Study Strengths

While there has been an increased focus on preventing errors in the healthcare setting, actions taken to make system corrections have not eliminated errors. A consensus for the need for a better understanding of the human factors that contribute to nursing errors is a strength of this study. A further strength is collecting the data from a Magnet system. Nurse participants work for a healthcare system where individual hospitals independently received Magnet designation followed by a second Magnet recognition for the entire system. Magnet designation means the hospital has met national criteria for the highest level of quality nursing care, as only five percent of hospitals in the United States are Magnet designated. Use of a Magnet Hospital system is a strength in this study as it allows some consistency of context for nurse error reporting to be assured.

Study Limitations

The low participation rate is a limitation. Concerns have been raised about a phenomenon called *research fatigue* which relates to the high demand for input which is easy to gather online. Pagano-Therrien (2013) wrote about HIV-infected youth who get

tired of being frequently asked to participate in research studies as part of a unique group. Nurses are also part of a unique group who have been the subject of considerable interest during the healthcare reform debate. For this reason, nurses may be getting more reluctant to participate in research because they are just tired of it, or are feeling fatigued or swamped and unable to take on another task. Regardless of the reason, the response rate of 21% is lower than anticipated and is a limitation; therefore, generalization of findings should be done with care.

Distribution of the survey through the hospital system department directors and managers may have limited the number of nurses reached with the request to participate. This distribution plan was debated at the Nurse Executive Committee level of the hospital system and was felt to be the best avenue to reach the most nurses and protect their anonymity should they choose not to take the survey. This limited the researcher's ability to know an exact number of nurses who received the request to participate and is a limitation of the study.

The study of nurses in a Magnet designated organization may limit generalization to the nursing population as a whole, and using nurses from a single system is acknowledged as a limitation. The nursing community may judge the findings on their own merit and may compare them with other hospital systems which operate on different management and error-identification style.

Conclusion

This study has given new insight into reasons nursing errors occur from the perspective of those who actually are at the sharp end of errors. Analysis of the major themes identified included loss of focus, unhealthy environment, interpersonal deficits,

and being overwhelmed. These factors may create a framework for better understanding of nurses' loss of attention when providing nursing care. Nurses who lose focus, for causes which are often simply part of human nature, can make errors that cause them to feel guilt and shame. Unhealthy work environments from a variety of factors may create distrust and workplace dissatisfaction, causing an environment where nurses are unwilling to speak up when change needs to occur. Interpersonal deficits can be overlooked by those who are responsible to fill staffing positions and manage units, but ultimately may be a cause of errors. Being overwhelmed, due to fatigue and swamping, is the one of the most likely reasons for errors to occur, and also the most important and the most common reason for errors according to the nurses in this study. However, these two situations are ones that nurses feel very little ability to change.

Further research into each of these human factors is needed to improve care that nurses provide to patients in order to decrease nursing errors. When the environment of safety is enhanced, not only the patient benefits, but all members of the healthcare team. Addressing change of healthcare delivery through a human factors perspective driven by the nurses at the bedside will begin a new perspective for nursing care delivery.

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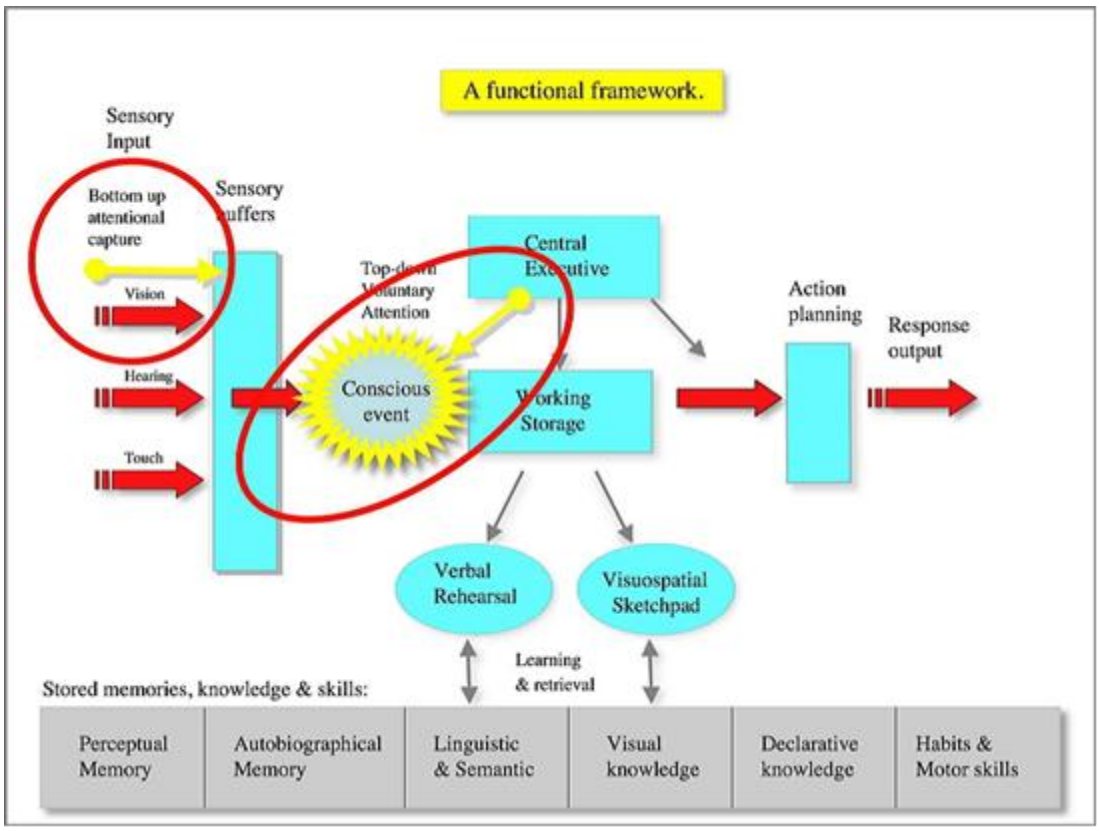

Figure 1. Baar's Global Workspace Theory. Baar's Global Workspace Theory is a functional framework that explores the relationship between sensory input, buffers, and how conscious events are moved into memory and action planning. Adapted from Baars, B. J. (1988). A cognitive theory of consciousness. New York, NY: Cambridge Univ. Press.

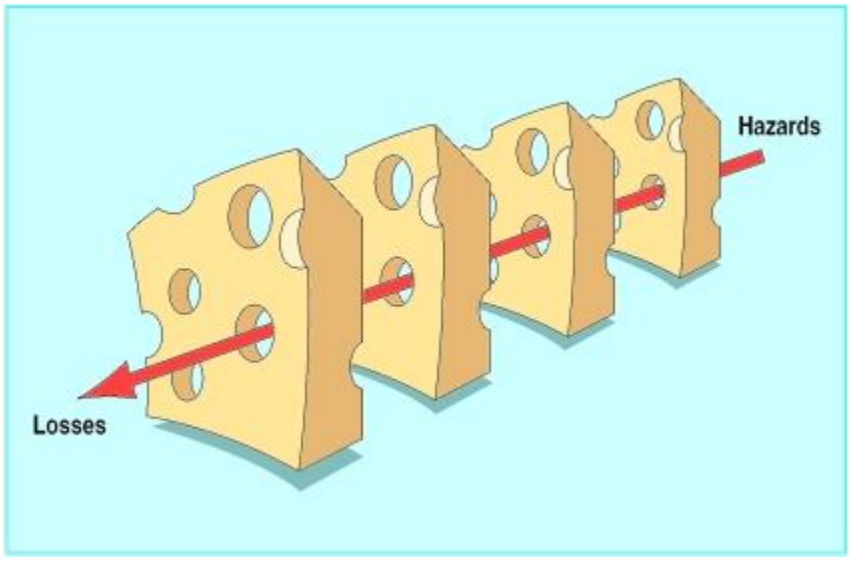

Figure 2. The Reason Swiss Cheese Model. The Reason Swiss Cheese Model demonstrates how defenses, barriers, and safeguards may be penetrated by an accident trajectory. Adapted from Reason, J. (2000). Human error: Models and management. British Medical Journal, 18(320), 768-770.

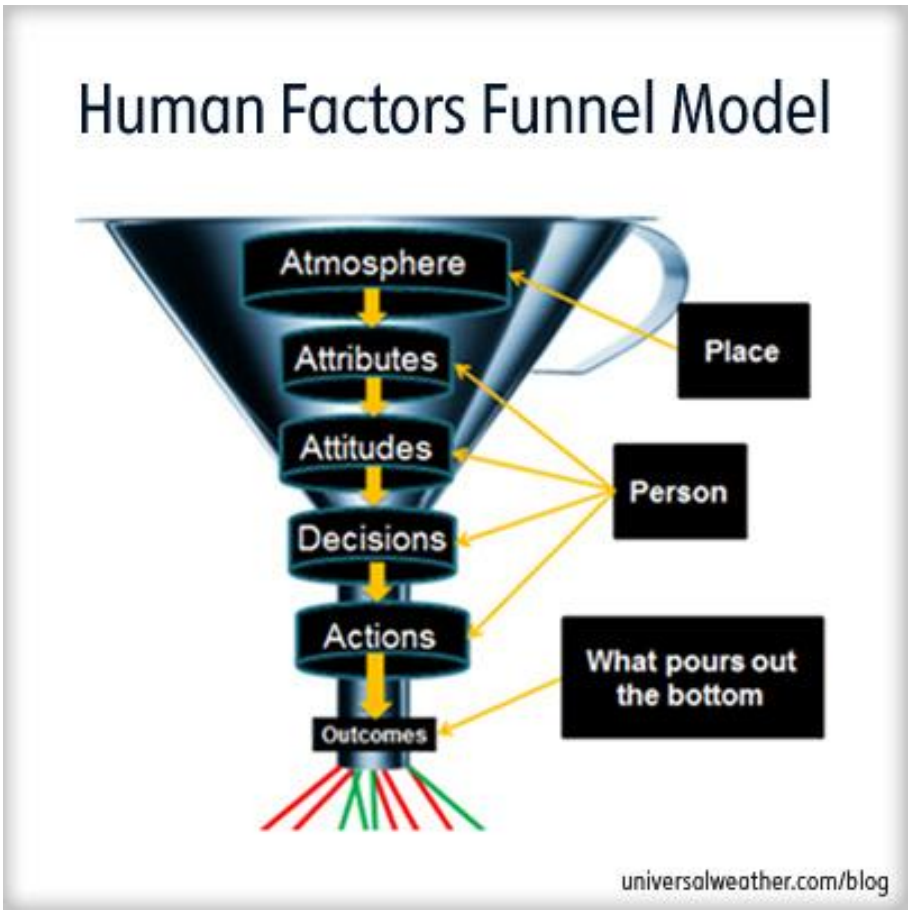

Figure 3. The Human Factors Funnel Model. The HFFM conceptual framework illustrates that there are many component parts throughout an organization that can impact error causation and accidents. Adapted from Baron, R. (2011). The human factors funnel model (HFFM): Another window on error causation. Unpublished manuscript, The Aviation Consulting Group.

Table 1. Conceptual and Operational Definitions of Study Variables

Variable	Conceptual Definition	Operational Definition
Human factors in nursing errors	Understanding interactions among humans and other elements of a system (Human Ergonomics Society, 2000)	Bivariate response to two items: 1. Have you ever made a medication error? (yes/no) 2. Have you ever made a medication error you did not report? (yes/no)
Likelihood	"the state of being likely or probable; probability" ("Likelihood," 2014, para. 1)	Ranked score on 24-item Likelihood Scale (researcher generated; no reliability and validity)
Importance	"having serious meaning or worth: deserving or requiring serious attention" ("Importance," 2013, para. 1)	Ranked score on 24-item Importance Scale (researcher generated; no reliability and validity)
Intervenability	"A purposeful nursing action that is done to the patient, family, or group that is setting dependent, directed by the nurse, disruptive to prior behavior, and reactive with the intention of a positive outcome" (Frame, 2004, p. 25)	Ranked score on 24-item Intervenability Scale (researcher generated; no reliability and validity)
Commonness (Common)	"Occurring or appearing frequently; most frequently seen kind" ("Common," 2014)	Ranked score on 24-item Commonness Scale (researcher generated; no reliability and validity)

Table 2. Demographics Hospital Nurse Survey

		n	%
Gender	Male	19	6
	Female	315	94
Race	Asian/Pacific Islander	5	2
	Hispanic/Latino	14	4
	Black/African American	2	1
	Caucasian/NonHispanic	290	86
	American Indian	3	1
	Other/Mixed	5	2
	Prefer Not To Answer	18	5
Highest Degree Obtained	Diploma Degree	16	5
	Associates Degree	66	20
	Baccalaureate Degree	175	53
	Masters Degree	71	21
	PhD/DNP Degree	5	2
Shift	Days	241	71
	Nights	85	25
Area Most Worked	Administration	11	3
	ER	33	8
	ICU	34	9
	Med/Surg	81	21
	Surgery/PACU	35	9
	OB	52	13
	Pediatrics	2	1
	Quality/Risk Management	6	2
Ever made nursing error?	Yes	266	68
	No	65	17
Made error but did not report?	Yes	69	18
	No	257	65

Totals in each category may not be the same in each category due to missing data.

Table 3. Top Ten Most Likely, Most Intervenable, Most Important, and Most Common Reasons to Cause Nursing Errors in Hospitals

Most Likely Reason to Cause Nursing Errors in Hospitals

	Mean	SD
1. Nurse impaired by a substance	9.13	2.39
2. Swamping	8.90	2.10
3. A problem with communication	8.90	2.51
4. A lack of critical thinking	8.56	2.44
5. Errors made by others that nurses are expected to recognize and fix	8.55	2.45
6. Nurse acting outside the scope of practice	8.05	2.39
7. Work is too fast-paced	7.92	2.26
8. Nurse placed in an unfamiliar circumstance	7.88	2.52
9. A problem with a policy or procedure	7.72	2.59
10. Fatigue due to lack of sleep.	7.70	2.25

Most Important Reasons to Cause Nursing Errors in Hospitals

	Mean	Std. Deviation
1. Swamping	8.85	1.51
2. Nurse impaired by a substance	8.58	2.32
3. Errors made by others that nurses are expected to recognize and fix	8.49	1.82
4. A problem with communication	8.45	1.94
5. A lack of critical thinking	8.23	2.07
6. Fatigue from lack of sleep	7.84	2.13
7. Work is too fast-paced	7.72	2.17
8. Fatigue due to too many hours worked	7.66	2.09
9. Nurse placed in an unfamiliar circumstance	7.50	2.30
10. A problem with technology	7.36	2.42

Most Intervenable Reasons to Cause Nursing Errors in Hospitals

	Mean	SD
1. Nurse impaired by a substance	8.56	2.32
2. Nurse acting outside the scope of practice	8.09	2.36
3. A problem with communication	7.92	2.29
4. A problem with teamwork	7.54	2.41
5. Errors made by others that nurses are expected to recognize and fix	7.52	2.36
6. Nurse is ill but continues to work	7.36	2.63
7. Nurse placed in an unfamiliar circumstance	7.22	2.61
8. A problem with technology	7.21	2.75
9. A language barrier	7.12	2.71
10. Lack of necessary resources or equipment	7.09	2.58

Most Common Reasons to Cause Nursing Errors in Hospitals

	Mean	Std. Deviation
1. Swamping	7.71	2.10
2. Work is too fast-paced	6.85	2.26
3. A problem with communication	6.59	2.51
4. Fatigue from too many hours worked	6.37	2.32
5. Errors made by others that nurses are expected to recognize and fix	6.28	2.45
6. Fatigue from lack of sleep	6.28	2.25
7. A lack of critical thinking	6.19	2.44
8. Nurse is ill but continues to work	5.91	2.64
9. A nurse who is apathetic or doesn't care	5.89	2.37
10. Distraction due to loss of focus	5.62	2.73

Table 4. Factor Analysis of Likelihood to Cause Nursing Errors in Hospitals

	Themes			
	Loss of focus	Unhealthy environment	Inappropriate actions by self or others	Overwhelmed
Distraction causing loss of focus	.783	.200	.115	.193
Distraction from a phone call	.663	.273		.231
Problem with technology	.660	.153	.269	
Unfamiliar circumstance	.611	.196	.102	.177
Inattentional Blindness	.599	.118	.295	.102
Work too fast paced	.477	.249		.386
Tasks done automatically or by rote	.471	.194	.370	.188
Language barrier	.461	.309	.156	.143
A problem with workplace satisfaction	.231	.807		.139
A poor work culture	.268	.745	.245	
Lack of team work	.175	.672	.291	.166
Ineffective or incorrect policies and procedures	.262	.566	.432	
Nurse feeling ill but still working	.400	.542	.189	.308
Apathetic or doesn't care about the work	.173	.482	.314	.259
Horizontal/Lateral violence	.355	.480		.384
Lack of resources	.436	.449	.329	
Nurse impaired by a substance	.107		.782	.103
A problem with communication, written or verbal	.230	.297	.678	
Errors made by others nurses are expected to fix	.255	.164	.643	.225
Lack of critical thinking	.158	.459	.633	.147
Nurse acting beyond the legal scope of practice	.176	.397	.448	.180
Fatigue from too many hours worked	.276	.112		.764
Fatigue from lack of sleep	.173	.167	.200	.724
Swamping too heavy work load			.203	.695
Eigenvalues	40.915	6.246	5.249	5.196
Alpha	.788	.841	.781	.704

Factors with shading were included in the component theme.

Table 5. Factor Analysis Themes by Demographic Groups

	Loss of Focus	Unhealthy Environment	Interpersonal Deficits	Overwhelmed
<BSN vs. BSN or higher	*t* = -1.70 *df* = 328 *p* = .09	*t* = -1.73 *df* = 322 *p* = .86	*t* = -1.01 *df* = 329 *p* = .31	*t* = -0.53 *df* = 328 *p* = .60
Day shift vs. night shift	*t* = 1.47 *df* = 321 *p* = .14	*t* = 0.04 *df* = 315 *p* = .97	*t* = 1.09 *df* = 120 *p* = .28	*t* = 3.01 *df* = 321 *p* = .00*
Made med error vs. no med error	*t* = -2.20 *df* = 326 *p* = .83	*t* = -1.09 *df* = 320 *p* = .28	*t* = -1.08 *df* = 327 *p* = .28	*t* = 0.55 *df* = 326 *p* = .58

*Significant at p < .05

Chapter 4. Summary and Conclusions

Despite years of research into error prevention, patients continue to suffer harm due to nursing errors. In a society where there is instant food, Instagram and internet postings, failure to find a quick fix for this ongoing issue is frustrating and difficult to understand. Looking at this problem from a new viewpoint has opened doors that could lead to improvements in safety for patients and nurses.

Overview of Findings

This body of work brings a new perspective to human factors contributing to nursing errors. While there is a need for patients and members of the healthcare team to understand "To Err is Human" (Kohn, Corrigan, & Donaldson, 2000), the attempt to fix human fallibility through system fixes has failed to eradicate errors. A healthcare culture dedicated to patient safety has not been carefully scrutinized regarding the human factors which are part of human nature and have limited ability to be modified. Many organizations, businesses, and healthcare dollars are dedicated to better understanding errors and developing cost-effective tools and systems to prevent the problems that lead to mistakes.

While focus on decreasing the cost of healthcare is necessary in the current financial climate, the answer may not be to increase the workload of nurses to the point where they are distracted, fatigued, overloaded, and swamped. These feelings lead to workplace dissatisfaction, a poor work culture for all team members, and horizontal or vertical violence. Burn-out and high nurse turnover only drive the costs of healthcare

higher, creating exactly the opposite effect desired in an environment of scarce resources and tightening budgets.

Understanding nursing's opinions of what human factors lead to errors is a beginning. Nurses are often at the sharp end of the error, responsible to catch and fix errors made by others. By asking nurses to identify the human factors that are likely to lead to nursing errors, and identification of the reasons which are most intervenable, important, and common, a base from which to better understand how to address these factors is formed.

Recommendations Based on Findings

This study should propel nursing to adopt a new outlook on patient safety improvement through the reduction of nursing errors. Further investigation is needed into each of these factors to better understand the nursing perspective presented. New ways should be explored to address the identified human factors.

When nurses evaluated human factors for *likelihood* to cause error, the factor with the highest mean score ($M = 9.13$) was *nurse impaired by a substance*. Nurses are often the first to suspect substance abuse behavior in fellow team members. Further education for nurses on signs of impairment would contribute to encourage identification of nurses working impaired. The second highest factor in causing an error is *swamping*. Swamping occurs when the workload is so heavy that the nurse has the inability to focus on the most important task. Nurses also rated *swamping* as the most important and most common reason to cause error. Discovering new ways to help nurses organize and keep focus should be of primary importance. Tools and new technology to help nurses focus

on the patient would enhance nurses' ability to attend to the most essential tasks and limit feelings of swamping.

When rating the most *intervenable* cause of nursing error, nurses indicated *nurse impaired by a substance* was number one. The second highest rating for intervenability was a *nurse acting outside the scope of practice*. Nurses clearly feel that those who operate outside that scope should be identified and corrected. This factor was not included in the top ten most common reasons to cause nursing errors, indicating that there are effective systems in place to identify and contain this factor. The third and fourth most intervenable causes were *a problem with communication* and *a problem with teamwork*. These factors go hand in hand and are an area that could be impacted by technology. Developing systems that are user-friendly and enhance communication could promote effective teamwork.

The most *important* reason to cause nursing errors identified was *swamping*. The second was *nurse impaired by a substance*. The third most important reason was *errors made by others that nurses are expected to recognize and fix*. This factor was also in the top five most intervenable reasons. Failure to hold all members of the team accountable for errors leads nurses to adopt feelings of impotence and frustration at their inability to bring about solutions to commonly accepted problems. Addressing unacceptable behaviors, especially those done with disregard to the impact they have on nursing, is a step that must be taken before a reduction in errors that reach the patient will happen.

The top two most *common* reasons to cause nursing errors were *swamping* and *work that is too fast-paced*. While seemingly related, these factors are separate in nature, as nurses rated *work that is too fast-paced* only seventh in the most likely and most

important scales. Nurses deal with work that is too fast-paced on many days, but feel that it causes errors most commonly when it leads to feelings of swamping and being overwhelmed. Nurses did not identify either factor in the top ten of the intervenability scale, rating *swamping* at only 6.57 and *work that is too fast-paced* at 5.74. Nurse leaders must address this factor and assist nurses to identify situations in which they feel their work is overwhelming in order to promote patient safety.

The four themes identified by factor analysis of the most likely reasons to cause nursing errors in hospitals were *loss of focus, unhealthy environment, interpersonal deficits,* and being *overwhelmed. Loss of focus* is a human factor that is unavoidable. Diversion of thought pathways occurs when attention to the primary task is lost. Recognition that loss of focus is the most likely reason to cause nursing errors should lead to new and innovative ways to provide nursing care. The development of a nursing model that identifies common reasons for loss of focus would enhance the understanding of how to intervene in the causation of nursing errors.

Nurses identified that working in an *unhealthy environment* is likely to cause errors. An unhealthy environment included a variety of factors, *including a poor work culture and a problem with workplace satisfaction, a lack of teamwork, ineffective policies and procedures,* and *a nurse feeling ill but still working*. Getting nurses engaged and committed to being part of solutions to environmental deficits through staff nurse councils and shared governance efforts is an important place to start. Working with nurses to identify and create innovative solutions to these problems could result in a healthier work environment that could in turn result in nurses better able to focus on their patients and feel satisfied with their careers.

Inappropriate actions by self and others was the third theme identified and includes *a nurse impaired by a substance, a problem with communication, errors made by others that nurses are expected to recognize and fix,* and *a lack of critical thinking*. A no-fault reporting system for errors or potential errors will increase the likelihood of stopping problems before they start. Holding all team members to the highest standard in behavior will improve the ability of nurses to focus on the patient and maintain concentration on the primary task

The fourth theme identified was feeling *overwhelmed*. The factors related to this theme are *fatigue, due to both lack of sleep and too many hours worked,* and *swamping*. Studies have shown mixed results on the relationship between shift work and overtime and resulting errors (Bellebaum, 2008; Scott, Rogers, Hwang, & Zhang, 2006). Looking at the results and not the cause may have produced these mixed results. Further work in understanding the impact of long shifts and overtime on the ability to maintain focus and attention could improve patient safety. Focused education for nurses on the impact of fatigue and swamping could assist in self-identification of periods when nurses are not at their best and unable to attend to the primary tasks.

This study has identified new areas of the provision of nursing care that should be addressed to improve patient safety. Further education for nurses in the area of substance abuse identification is needed. Assisting nurses to identify and remediate when they are feeling swamped or overwhelmed and implementing pathways to intervention will improve patient safety. Technology that leads to improved communication and teamwork should be the focus of nursing leaders wishing to impact patient safety. Holding all team members accountable for their actions and recognizing the potential

impact on errors that each team member shoulders should assist with an improvement in teamwork and workplace satisfaction. Identification of the impact long shifts and overtime have on inability to maintain focus could have a lasting impact on the way nursing care is delivered.

Work on the identified factors and themes may prompt nursing leaders to redefine the most effective way to deliver nursing care. Pioneering innovation in safer nursing care delivery will take courage and a willingness to change the current paradigm. The development of a framework for understanding the manner in which all these factors and themes are related could lead to a decrease in nursing errors in hospitals and an improvement in patient safety.

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Appendix A. Survey 1

Dear colleague,

Thank you for considering participation in this dissertation study "A Proposed Framework for Understanding Human Factors Contributing to Nursing Errors ". You have been chosen to be a part of the Expert Group of nurses in the initial round of this Delphi Study because of your experience as a nurse and/or your experience with Quality Assurance, Risk Management, or Patient Safety.

As the Primary Investigator of this study, I have a significant interest in the area of nursing errors and their relationship to human factors. With 35 years of nursing practice, I have often looked at nursing errors and wondered how a nurse could make such a mistake. This study will look into the deep reasons behind the occurrence of errors and the human factors from which they result.

Any participation in this group is entirely voluntary, and you may discontinue your participation at any time without giving reason simply by emailing croth@shc.org. By responding to this email (Stage I) and the follow-up email (Stage II), you give your consent to participate. Please see the attached consent for further details prior to responding.

Instructions:

1. Read the attached consent. Make the decision to participate or not to participate. If you decide **not** to participate, please email croth@shc.org and indicate your desire. If you decide to participate, please place your initials here: _____

2. Answer the following demographic questions: *(All information, including your identity and email address, will be kept confidential and known only to the researcher. The hospital system will not have any access to your answers.):*

a. Years in nursing practice: _____

b. Age: _____

c. Race/Ethnicity: _____ (Options: Asian/Pacific Islander, Hispanic/Latino, Black/African American, Caucasian/NonHispanic, American Indian, Other/Mixed)

d. Highest Degree Obtained: _____ (Options: Diploma, Associates Degree. Baccalaureate, Masters Degree, PhD/DNP)

e. Which shift do you primarily work? _____ (Options: Days, Nights, Other)

f. Which general area of the hospital do you work? _____ (Options: ER, ICU, Med/Surg, Surgery/PACU, OB, Quality/Risk Management, Other – Please Indicate)

3. Please answer the following request: **Please tell me all of the things you can think of that might contribute to a medical error. List as many as you wish.** Please take your time to think about these answers, and think beyond the surface issues. For example, instead of listing "fatigue", indicate "the nurse just worked her third 12 hour shift in a row and cannot keep her concentration", or "the nurse was unable to sleep prior to coming onto a night shift, and cannot focus".

   Your answers:

   One last question, a common form of medical error involves medications. You may answer the following questions or omit them, but I would like to know:

a. Have you ever made a medication error? ____Yes ____No (Please indicate correct answer with an X)

b. Have you ever made a medication error you did not report? ____Yes ____No (Please indicate correct answer with an X)

5. Please return this email to croth@shc.org ("Reply") within the next two weeks with your answers. After 10 days, a reminder email will be sent to you if you have not responded. By November 1, a second email will come to you with a link to a survey that lists the common themes from the nurse experts, asking you to consider their importance. The second email should take less than 15 minutes of your time.

   Definitions:

   Nursing errors: Errors are planned activities that fail to achieve their goal, when such failures are not due to chance alone (Reason, 1990). Nursing errors are those errors that occur in the healthcare setting during the process of delivering care (Grober & Bohnen, 2005).

   Human Factors: The International Ergonomics Association (as cited in Human Ergonomics Society, 2000) defines human factors (which is also termed ergonomics) as the "scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance" (para. 5).

   Thank you for your participation. I look forward to your thoughts.

   Cheryl Roth, WHNP-BC, RNC. MSN, RNFA

   Nurse Practitioner, L&D, Scottsdale Healthcare

Appendix B. Survey 2

Q1 Thank you for your willingness to help with this second part of the Human Factors Contributing to Nursing Errors study to help determine how to mitigate nursing errors in the clinical setting. Your initial input was greatly appreciated and has been collapsed into a list which is presented below in random order. Please look at each item and mark on the response line how important you think this item is to the issue of nurses making an error in the clinical setting. You may score it from "not important at all" to "extremely important" using the 1-10 indicators. I will find the items with the highest scores and use them in a survey of a large number of nurses in clinical practice. Your contribution to the rigor and validity of this survey cannot be understated. I am very grateful for your interest and participation. Please indicate how important EACH of the items below is to the issue of nurses making an error in the clinical setting.

Appendix B. (Continued)

	Not Important At All	2	3	4	5	6	7	8	9	Extremely Important
1. Fatigue, from lack of sleep	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
2. Fatigue, from too many hours worked	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
3. Swamping, too heavy work load	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
4. Work is too fast-paced.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
5. Non-clinical demands (concerns re: HCAPS scores, SCIP measures, patient satisfaction)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
6. Lack of nursing competency or knowledge regarding a patient condition or medication	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
7. Horizontal/ Lateral violence - fear of the nurse from other's inappropriate behavior (nurse:nurse or provider:nurse)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
8. Nurse is placed in an unfamiliar circumstance (patient type or unit type)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
9. Nurse who is apathetic or doesn't care about the work	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
10. Distraction from a phone call	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
11. Distraction causing loss of focus (emergency call, fire alarm, interruption)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
12. Inattentional blindness (being so focused on one thing that you fail to recognize something else that is a problem)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
13. A problem with a language barrier	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
14. Nurse feeling ill but still working	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Appendix B. (Continued)

	Not Important At All	2	3	4	5	6	7	8	9	Extremely Important
15. Nurse impaired by a substance (narcotics, alcohol, etc.)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
16. A problem with technology (computers, pumps, etc.)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
17. Lack of resources or unavailability of the appropriate tools and supplies	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
18. A problem with required documentation	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
19. A problem with work space design, environment, or noise	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
20. Errors made by others that nurses are depended on to catch and correct	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
21. Tasks done automatically or by rote	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
22. Lack of critical thinking	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
23. Nurse acting beyond the legal scope of practice	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
24. Lack of team work	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
25. A problem with communication, written or verbal	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
26. A problem with workplace satisfaction	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
27. A poor work culture	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
28. Unrealistic or inefficient policies and procedures	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Appendix C. Initial Request with the Link to the Anonymous Survey to the Nurse Managers and Directors from the Director of Quality

To all RN's:

Below is the link to a survey about the causes of nursing errors. The answers you give in this survey will be completely anonymous and not individually revealed to the hospital. You may choose to enter a drawing for an electronic tablet at the end of the survey, but your name will *not* be linked with your answers. There will be no personal benefit to you (unless you are the winner of the tablet) except for the satisfaction of knowing you helped with nursing research that might improve patient safety and the quality of nursing care.

Thanks!
Chrys

Chrys Anderson, DNP, RN, CPHQ
Director, Quality Outcomes

Dear RN:

I am the Nurse Practitioner in Labor & Delivery at SHC, working on my PhD dissertation. My topic is "Human Factors Contributing to Nursing Errors". I want to find out what things make nurses vulnerable to errors. The first part of my study used an Expert Panel made up of nurses who study errors and staff nurses to come up with a list of things that may contribute to the occurrence of nursing errors.

The next part of my study is to ask you, the nurse working at the bedside, what you think about these factors. The attached link will take you to the survey. It should take about 10-15 minutes to complete. The information you give will be completely anonymous, and your personal response will not be shared with the hospital.

At the end of the survey, you will be given the opportunity to give your name and email address to be placed in a drawing for an electronic tablet (iPad or Windows, your choice). If you do give this information, it will not be linked to your response in any way.

Please click on this link, or cut and paste into your browser:
http://uttyler.qualtrics.com/SE/?SID=SV_1Sr74zcCg4TUS8J

I am so thankful for your willingness to participate. You may help make this world a safer place for patients and nurses!

Cheryl Roth, WHNP-BC, RNC-OB, MSN, RNFA

Appendix D. Survey 3

Human Factors Contributing to Nursing Errors

Q1 Thank you for your willingness to help with this survey studying Human Factors Contributing to Nursing Errors. The purpose is to help determine how to reduce nursing errors in the clinical setting. Your input is totally anonymous. At the end of the survey, you will be given the opportunity to go to a separate link to give your contact information if you would like to be entered into a drawing for an electronic tablet. Your contact information cannot be connected to your survey information and will not be shared with anyone. Participation in this survey is entirely voluntary, and you may discontinue participation at any point. Anonymous individual survey results will only be available to the researcher and her dissertation chair and will not be given to anyone at Scottsdale Healthcare. General data will be grouped together to be included in future publication. Please consider each human factor that might contribute to nursing errors and rate the questions below it on the scale given.

****
****

Appendix D. (Continued)

	How likely is this item to cause a nursing error?	**How important is this item to the chance of an error?**	**How much ability does the nurse have to intervene is this item?**	**How common is this item in nursing errors in your hospital?**
Fatigue from lack of sleep	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Fatigue from too many hours worked	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Swamping too heavy work load	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Work too fast paced	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Non-clinical demands	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Lack of nursing competency or knowledge	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Horizontal/Lateral violence	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Unfamiliar circumstance	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Apathetic or doesn't care about the work	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Distraction from a phone call	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Distraction causing loss of focus	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Inattentional blindness	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Language barrier	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Nurse feeling ill but still working	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Nurse impaired by a substance	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Problem with technology	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Lack of resources	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Problem with required documentation	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Problem with work space design, environment, or noise	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Errors made by others nurses are expected to fix	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Tasks done automatically or by rote	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Lack of critical thinking	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Nurse acting beyond the legal scope of practice	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Lack of team work	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
A problem with communication, written or verbal	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
A problem with workplace satisfaction	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
A poor work culture	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10
Ineffective or incorrect policies and procedures	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10	1-2-3-4-5-6-7-8-9-10

Q36 Please answer the following demographic questions. They will help us evaluate the information you provided. What is your gender?

- ❍ Male
- ❍ Female

Q28 How many years have you been a nurse?

Q29 What is your age?

Q30 What is your race/ethnicity?

- ❍ Asian/Pacific Islander
- ❍ Hispanic/Latino
- ❍ Black/African American
- ❍ Caucasian/Non-Hispanic
- ❍ American Indian
- ❍ Other/Mixed
- ❍ Prefer not to answer

Q31 What is the highest degree you have obtained (completed)?

- ❍ Diploma
- ❍ Associates Degree
- ❍ Baccalaureate
- ❍ Masters Degree
- ❍ PhD, DNP

Q32 Which shift do you generally work?

- ❍ Days
- ❍ Nights
- ❍ Other

Q33 Which best describes the area you usually work in?

- ❍ Administration
- ❍ ER
- ❍ ICU
- ❍ Med/Surg
- ❍ Surgery/PACU
- ❍ OB
- ❍ Pediatrics
- ❍ Quality/Risk Management
- ❍ Other

Q34 Have you ever made a medication error?

- ❍ Yes
- ❍ No
- ❍ Prefer not to answer

Q35 Have you ever made a medication error that you did not report?

- ❍ Yes
- ❍ No
- ❍ Prefer not to answer

Appendix E. Request Letter of Director of Research, Scottsdale Healthcare

Cheryl K. Roth, WHNP-BC, RNC, MSN, RNFA
5001 E. Main St. #244
Mesa, AZ 85205
Croth2@patriots.uttyler.edu or croth@shc.org

October 10, 2013

Dr. Melanie Brewer
Director of Research
Scottsdale Healthcare
9003 E. Shea Blvd.
Scottsdale, AZ 85260

Dear Dr. Brewer,

As you are aware, I have been attending the PhD in Global Nursing at the University of Texas at Tyler (UTTyler). I have gotten approval of my Dissertation Proposal from my dissertation committee and am submitting IRB applications to Scottsdale Healthcare (SHC) and UTTyler. My proposed study topic is Human Factors Contributing to Nursing Errors.

This study involved three email surveys. The first two studies will be done with a set of nursing experts, such as Quality Assurance and Risk Management nurses from Arizona and Texas, and randomly chosen nurses who are employed at SHC. A third survey confirming the findings of the first two surveys will then be sent to the nurses at SHC.

Please grant permission for the nurses at SHC to be sent this survey. They will be consented and their identification will be known only to myself (the Primary Investigator) and possibly my dissertation chair, Dr. K. Lynn Wieck. This study must also be accepted by the Institutional Review Boards at SHC and UTT prior to implementation.

Thank you for your consideration.

Sincerely,

Cheryl Roth, RNC, MSN, WHNP, RNFA

Appendix F. Dr. Brewer's Permission

Dear Cheryl,

It is my pleasure to support your proposed research study, *Human Factors Contributing to Nursing Errors*. I look forward to learning more about your project and to supporting your work across all levels of nursing in the organization. Please don't hesitate to contact me if I can be of assistance.

Sincerely yours,

Melanie

Melanie Brewer, DNSc, RN, FNP-BC
Director, Nursing Research
9003 E. Shea Blvd.
Office: (480)323-1230

Appendix G. IRB UTTyler Permission

The University of Texas at Tyler
Institutional Review Board

October 18, 2013

Dear Ms. Roth,

Your request to conduct the study: *Human Factors Contributing to Nursing Errors,* IRB #F2013-25 has been approved by The University of Texas at Tyler Institutional Review Board under expedited review. This approval includes the Scottsdale HealthCare written informed consent that is attached to this letter, and your assurance of participant knowledge of the following prior to study participation: this is a research study; participation is completely voluntary with no obligations to continue participating, with no adverse consequences for non-participation; and assurance of confidentiality of their data. In addition, please ensure that any research assistants are knowledgeable about research ethics and confidentiality, and any co-investigators have completed human protection training within the past three years, and have forwarded their certificates to the IRB office (G. Duke).

Please review the UT Tyler IRB Principal Investigator Responsibilities, and acknowledge your understanding of these responsibilities and the following through return of this email to the IRB Chair within one week after receipt of this approval letter:

- This approval is for one year, as of the date of the approval letter
- Request for Continuing Review must be completed for projects extending past one year
- Prompt reporting to the UT Tyler IRB of any proposed changes to this research activity
- **Prompt reporting to the UT Tyler IRB and academic department administration will be done of any unanticipated problems involving risks to subjects or others**
- Suspension or termination of approval may be done if there is evidence of any serious or continuing noncompliance with Federal Regulations or any aberrations in original proposal.
- Any change in proposal procedures must be promptly reported to the IRB prior to implementing any changes except when necessary to eliminate apparent immediate hazards to the subject.

Best of luck in your research, and do not hesitate to contact me if you need any further assistance.

Sincerely,

Gloria Duke, PhD, RN

Gloria Duke, PhD, RN
Chair, UT Tyler IRB

Appendix H. IRB SHC Permission

SCOTTSDALE HEALTHCARE
Research Institute

November 21, 2013

Cheryl Roth, NP
SHC - Labor & Delivery
9003 E. Shea Blvd
Scottsdale, AZ

RE: **SHC IRB #2013-067**: Your new submission received on 10/23/2013 regarding Human Factors Contributing to Nursing Errors (None)

Dear Ms Roth:

I have reviewed your request for expedited approval of the new study listed above. Your study is eligible for expedited review under FDA and DHHS (OHRP) Category 7. Research on Individual or group characteristics or behavior designation.

This is to confirm that as of 11/13/2013 I have approved your application. The protocol is approved through version dated 10/10/2013. You must obtain informed consent from all subjects; however, signed written consent is not required. In reviewing your consent procedure for this study, your inclusion of the following special classes of subjects was taken into account: Pregnant Women, Employees, Racial Minorities

The following documents were taken into consideration during the review of this study:
Expedited Application dated received 10/24/2013
Protocol Summary 10/10/2013
Waiver of HIPAA Authorization-Approved
Fee Waiver Request-Approved
Consent Statement

You are granted permission to conduct your study as described in your application effective immediately. The study is subject to continuing review before the expiration date of **11/13/2014**, unless closed before that date.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Kituria V. Gaines (480-323-3071; fax 480-323-3208; email: Kgaines@SHC.org) if you have any questions or require further information.

Sincerely,

Robert A. Marlow MD

Robert Marlow, MD-IRB Chair

10510 N 92nd Street, Suite 300, Scottsdale, AZ 85258
Ph: 480-323-3071 Fax: 480-323-3208

Institutional Review Board 1-FWA00001751

Appendix I. Consent Form

SCOTTSDALE HEALTHCARE INSTITUTIONAL REVIEW BOARD

Consent to Participate in Research

Protocol Name: Human Factors Contributing to Nursing Errors

Sponsor: N/A

Principal Investigator: Cheryl Roth, RNC, MSN, WHNP-BC, RNFA

Contact Name and Telephone: Cheryl Roth, 480-352-1556

Introduction

You are invited to consider taking part in this research study because you have expertise in risk management or quality assurance, or are a nurse working in a large hospital system. We want your ideas about human factors that may contribute to nursing errors. This form will describe the purpose and nature of the study, the possible risks and benefits, other options available to you, and your rights as a participant in the study. The decision to participate is yours. If you decide to take part, please check the box on the original email about the study and send back to me.

Background and Purpose of the Study

The purpose of this study is to determine which human factors contribute to nursing errors. We all know that errors in hospitals have dire consequences, so finding out how to help nurses avoid errors is an important contribution to hospital safety.

Total Number of Participants

About 530 people will take part in this study at Scottsdale Healthcare at all campuses, and with Risk Managers and Quality Assurance nurses at other institutions. People in the study are referred to as "participants." All participants will be enrolled at this site.

General Plan of This Study

This study will involve three surveys. The first survey will involve an open-ended question asked to a group of 30 participants who are experienced in nursing. Their answers will be put together in groups and these answers will be sent to the same group to rate the importance of each item to nursing errors. These answers will be put consolidated by statistical methods, and a third survey will be sent out to a larger group of nurses to see if their ratings agree with those of the smaller group.

How you were chosen to be a participant in this Study

You were chosen to be one of the participants because you either work in the area of risk management or quality assurance, or because you are a nurse at Scottsdale Healthcare.

Length of the Study for Each Participant

If you are in the small group, you will be asked to participate by answering the first question by email, and subsequently scoring a group of answers for their importance in an email survey about four weeks later. The time to respond to the two surveys is about 10-15 minutes each. If you are in the second, larger group, you will respond to one survey only which should not take longer than 10-15 minutes.

Possible Benefits of Participating in the Study

We cannot guarantee that you will experience any benefits from participating in this study. However, others may benefit in the future from the information we obtain while you are in this study.

Possible Side Effects and Other Risks of Participating in the Study

You are unlikely to experience side effects as a result of participation in this study. We will take reasonable safeguards to minimize known and potential risks but unknown and/or unanticipated side effects might occur.

Who Can Participate?

This study is designed for nurses, at least 18 years of age, who are actively employed in nursing. Your may participate in this study if:

- you are working in the area of risk management or quality assurance, or
- you work as a nurse at Scottsdale Healthcare.

Who Cannot Participate

Only those invited to be in the study will be eligible to participate.

Other Options

If you do not wish to participate in this study, or do not meet the criteria, you may decline to answer the survey questions at any time for any reason without explanation. The decision will be up to you.

Confidentiality of the Data Collected During the Study

Every effort will be made to keep your identity and information confidential, as well as any other personal information that we gather during this study. Please see the attached "Authorization to Share Protected (personal) Health Information (PHI) in Research."

Whenever data from this study is published, your name will not be used.

No persons will be identified in publications or presentations of the findings.

Electronic Data Security

Only authorized users will have access to information about your participation in this study stored in a password protected computer. We will take all reasonable precautions to protect it from unauthorized disclosure, tampering, or damage.

New Findings

After the study, we will tell you about new information we gather about human factors relating the nursing errors under research in this study, and any information that may affect your interest in remaining in the study.

Costs to You for Participating

There will be no cost to you for participating.

Payments to the Principal Investigator, Institution/Hospital

The principal investigator for this trial, Cheryl Roth, is not receiving payment for the time spent completing study related duties outside of her normal compensation for working at Scottsdale Healthcare. The hospital is not receiving payment from anyone for your participation. Neither you nor your insurance will have additional costs related to this study.

Payments to You for Participating

Study participants will not be paid for participating in this study. You may choose to register for a drawing for an electronic tablet.

Your Rights as a Participant in the Study

Participation in this study is entirely voluntary. You have the right to leave the study at any time and may do so by simply not responding to the voluntary online survey(s).

Leaving the study will not result in any penalties of any kind. Whether you decide to participate or not to participate or to withdraw, your employment will not be affected in any way.

Problems and Questions

Call Cheryl Roth at 480-323-3895 day or night if you have questions about the study, any problems, or think that something unusual or unexpected is happening. You may also contact the Dissertation Committee Chair, Dr. J. Lynn Wieck at 281-375-8155.

Regulatory or Ethical Issues

The Scottsdale Healthcare Institutional Review Board (IRB) and the University of Texas at Tyler IRB have reviewed this document for compliance with federal guidelines, and ethics. If you have questions about your rights as a research participant, you may call or write: IRB Coordinator or Robert Marlow, MD, Chair, IRB, 9003 E. Shea Blvd., Scottsdale, AZ 85260, 480-323-3071 or the Institutional Review Director from The University of Texas at Tyler, Dr. Gloria Duke at 903-566-7023.

Withdrawal by Investigator, Physician, or Sponsor

The investigators may stop the study or take you out of the study at any time should they judge that it is in your best interest to do so, or if you do not comply with the study plan. They may remove you from the study for various other administrative reasons. They can do this without your consent.

Investigator's Statement

I have fully explained this study to the participant. I have discussed the email survey process, the possible risks and benefits, the standard and research aspects of the study, and have answered all of the questions that the participant may have asked. Confirmation of Investigator will be sent by email to the participant.

Participant's Consent

By affirming consent on the survey, you indicate that you have read the information provided in this Informed Consent Form. All of your questions were answered to you satisfaction. You voluntarily agree to participate in this study. [Upon affirming consent and confirmation of the investigator, you will receive an electronic copy of this form, and a copy will become part of your participant record.]

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Cheryl K. Roth	Nurse Practitioner, Labor & Delivery Scottsdale John C. Lincoln Healthcare Network. Scottsdale, Arizona

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Hesston College – Hesston, KS	ADN	1978	Nursing
University of Texas Health Science Center School of Nursing – Houston, TX	BSN	2004	Nursing
University of Texas Health Science Center School of Nursing – Houston, TX	MSN	2006	Nursing – WHNP
University of Texas at Tyler – Tyler, TX	PhD	2014	Nursing - PhD

A. Positions

2/28/2011 – present	Women's Health Nurse Practitioner Labor & Delivery	Scottsdale Healthcare, Shea Scottsdale, AZ
6/2007 – 9/2010	Women's Health Nurse Practitioner	Today's Women's Health Specialists, Chandler, AZ
1/2007 – 5/2007	Adjunct Faculty	Texas Woman's University, Houston, TX
10/2002 – 10/2006	Director, Women & Newborns	Conroe Regional Medical Center, Conroe, TX
4/2002 – 10/2002	Education Specialist	Park Plaza Hospital, Houston, TX
1996 – 4/2002	Director of Women's Services	Park Plaza Hospital, Houston, TX
1988 – 1996	Nurse Clinician, Assistant Head Nurse, Staff Nurse	The Methodist Hospital, Houston, TX
1987 – 1988	Staff Nurse	The Woman's Hospital, Houston, TX
1983 – 1987	Senior Staff Nurse	Carle Hospital, Urbana, IL
1981 – 1983	Charge Nurse	Henderson Hospital, Henderson, NE
1981 – 1983	Labor & Delivery Call Nurse	Aurora Hospital, Aurora, NE
1979 – 1981	Director of Nursing	Hamilton Manor, Aurora, NE
1978 – 1979	Charge Nurse, Pediatrics	Carle Hospital, Urbana, IL

B. Licensure/Certification

2008	Professional Nursing Seminars	RN First Assistant
July 2006 – present	NCC	Women's Health Nurse Practitioner
May 2006 – present	Board of Nurse Examiners State of Texas/Arizona	Women's Health Nurse Practitioner
1990- present	NCC	RNC, Inpatient Obstetrics
1990 – 2006, 2012 – now	American Heart Assoc.	BLS Instructor
1994 - present	AWHONN	AWHONN Fetal Monitoring Instructor
1992 - 2006	American Academy of Pediatrics	Neonatal Resuscitation Instructor
2004 - present	AWHONN	AWHONN Fetal Monitoring Instructor Trainer
1994 – 2005, 2011 - now	American Heart Assoc.	ACLS Certification, Instructor

C. Honors/Professional Memberships:

2004	Leader of the Quarter, Conroe Regional Medical Center
2004	Exemplary Student Award, University of Texas School of Nursing
2004	Sigma Theta Tau, University of Texas School of Nursing
2005	Frist Award Nominee, Conroe Regional Medical Center
2006	Who's Who in University and College Students
2007	March of Dimes Recognition for Outstanding Volunteerism

D. Publications (* = refereed)

"The OB Patient with Aortic Aneurysm: A Case Study" Journal of OB/GYN Nursing, July/Aug. 1992. 21(4), 310-317.*

"Obstetrics in the Intensive Care Setting" Nursing Avenues, Sept., 1992, V(3), 6-7.*

"Real Nurses" Nursing Avenues, August, 1994; The Methodist Times, September 30, 1994; The TMC News, May, 1995; The Journal, October, 1995.

"Labor & Delivery: Expect the Unexpected" Expectant Mother's Guide To Houston, 2000 Edition.

"Doulas", The Expectant Mother's Guide of Houston, September, 2001, Spindletop Publishing.

"The Path To Becoming a RNFA" ADVANCE Nurse Practitioners Journal, April, 2009

"The OB Patient with Aortic Aneurysm: A Case Study" Journal of OB/GYN Nursing, July/Aug. 1992. 21(4), 310-317.