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# Impact of Nurse Fatigue and Nursing Handoffs on Patient and Nurse Safety

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# IMPACT OF NURSE FATIGUE AND NURSING HANDOFFS ON PATIENT AND NURSE SAFETY

by

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IMPACT OF NURSE FATIGUE AND NURSING HANDOFFS ON PATIENT AND NURSE SAFETY

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In healthcare today, patient safety continues to be a major concern. Nurse fatigue from long work shifts and inadequate patient handoffs may lead to errors and near errors that harm patients and nurses. The intent of this study was to fill a gap in understanding the effect shift length has on patient safety and maternal newborn nurses' personal safety. A cross sectional survey design was administered via Qualtrics, a web-based online software program. Participants included two groups of maternal newborn nurses. One group worked 8-hour shifts (N = 70) and the other group worked 12-hour shifts (N = 151). Statistical analyses using *t*-test and Mann-Whitney U revealed maternal newborn nurses who worked 12-hour shifts reported experiencing more fatigue, making more errors, and sustaining more work-related injuries and accidents than those reported by maternal newborn nurses who worked 8-hour shifts. Maternal newborn nurses who worked 8-hour shifts reported poorer quality handoffs than those who worked 12-hour shifts. The associations between acute fatigue and the perception of fatigue with nurse work-related injuries and accidents were both statistically significant. Using multiple regression, fatigue and poor quality handoffs were both shown to significantly predict

patient errors and near errors, which also may have clinical significance for patients, nurses and employers.

# Chapter One

## Overview of the Research Study

Numerous studies on nurse fatigue, patient handoffs and their impact on patient safety and nurses' personal safety have been published. Some of those studies demonstrated that fatigue associated with long shifts can harm patients (Barker & Nussbaum, 2011; Geiger-Brown et al., 2012; Hazzard et al., 2013; Olds & Clarke, 2010) and nurses (Olds & Clarke, 2010; Edwards, McMillian, & Fallis, 2013; Johnson, Brown, & Weaver, 2010; Trinkoff et al., 2008). Other studies revealed handoffs, particularly poor quality handoffs, also has been associated with harm to patients (Ebright, Urden, Patterson, & Chalko, 2004; Friesen et al., 2008; Riesenberg, Leitzsch, & Cunningham, 2010). The purpose of this research was to determine the shift length, 8- versus 12-hours, that has the highest association with more fatigue among maternal newborn nurses and had poorer handoff quality and the impact each of these had on patient safety and nurses' personal safety. It was hypothesized that maternal newborn (MN) nurses who worked 12-hour shifts would report experiencing more fatigue, making more errors and near errors, and suffering more work-related injuries and accidents. It was also hypothesized that there would not be a difference in handoff quality between the two groups. A cross sectional survey design was administered via Qualtrics, a web-based online software program. A random national sample of maternal newborn nurses provided two groups, a group of nurses who worked 8-hour shifts and another group that worked 12-hour shifts.

## Introduction of Articles

The primary investigator's (PI) interest in nurse fatigue began years before applying to The University of Texas at Tyler. Having worked as a bedside nurse for more

than 20 years, I have had personal experience with work-related fatigue. The worst time was between 4 am and 6 am, and while driving home after working a 12-hour night shift. Some nights consuming numerous caffeinated beverages in an attempt to stay awake only seemed to result in tremors. For me, those caffeinated beverages did not result in being more awake or less tired. I experienced a near miss automobile accident while driving home after working a 12-hour night shift, and also witnessed the fatigue other nurses have experienced at the end of a 12-hour shift.

As a result of this personal experience with fatigue, the original intent of this research study was to develop an intervention for bedside nurses to mitigate the effects of fatigue thus improving patient and nurses' safety. A literature review presented in Chapter 2, *Nurse Fatigue: An Evidence Review*, examined studies that reported the physiological (Geiger-Brown et al., 2012) and psychological effects (Barker & Nussbaum, 2011; Hazzard et al., 2013) nurse fatigue had on patient safety (Olds & Clarke, 2010; Edwards, McMillan, & Fallis, 2013; Scott, Rogers, Hwang, & Zhang, 2006) and nurses' personal safety (Olds & Clarke, 2010; Edwards et al., 2013). It also examined articles that discussed nursing activities that contributed to the development of fatigue (Chen, Daraiseh, Davis, & Pan, 2014) and interventions that may mitigate work-related fatigue (Chen et al., 2014; Edwards et al., 2013).

However, while in the process of designing this research study, a conversation with a member of upper management at a local community hospital quickly changed the focus to determining the impact of shift length (including fatigue and handoff quality), on patient errors, and nurses' personal safety. A search of the literature did not produce any studies that compared the effects of fatigue and handoffs on incidence of patient safety

and nurses' personal safety. No studies were found that focused solely on nurses who worked in maternal newborn areas. Therefore, the focus of this research study changed to determine which shift length, 8- versus 12-hours, was associated with more harm to maternal newborn patients and nurses.

The results of this study are reported in Chapter 3, *Impact of Nurse Fatigue and Nursing Handoffs on Patient and Nurse Safety*. This study showed there are differences in the level of fatigue between nurses working 8- and 12-hour shifts, but no differences in handoff quality.

Chapter Two

# Nurse Fatigue: An Evidence Review


## Abstract

The purpose of this paper is to synthesize research articles focused on acute work-related fatigue experienced by bedside nurses who work 12-hour shifts. Inclusion criteria were 1) studies published in peer-reviewed journals; 2) written in English; 3) examining nurse work schedules (specifically 12-hour shifts); 4) and the effects of acute work-related fatigue on nurses' ability to provide safe care. A total of 23 articles met the inclusion criteria. Findings showed acute work-related fatigue had a negative effect on nurse performance as well as nurses' and patients' safety. Several articles mentioned interventions for combating acute work-related fatigue, and several articles recommended future research.



*Keywords*: work-related fatigue, nurse safety, patient safety

# Nurse Fatigue: An Evidence Review

As of May 2012, there were 2.6 million Registered Nurses (RN) in the United States. Approximately 1.5 million of them worked in hospitals (United States Department of Labor, 2014). Many hospital nurses now work 12-hour shifts since few hospitals offer other options. Studies showed that working 12-hour shifts can lead to fatigue, which can negatively affect nurse performance. Studies also revealed that this acute work-related fatigue can impact not only nurse performance, but also nurses' personal safety (Johnson, Brown, & Weaver, 2010; Olds & Clarke, 2010), and patient safety (Olds & Clarke, 2010; Scott, Rogers, Hwang, & Zhang, 2006).

The purpose of this review is to identify pertinent literature about nurse acute work-related fatigue that can result from 12-hour shifts, the potential impact it has on nurses' personal safety and patient safety, measures to combat acute work-related fatigue, and areas in need of additional research. Nurse acute work-related fatigue is defined as an "overwhelming sense of tiredness, lack of energy, and a feeling of exhaustion associated with impaired physical and/or cognitive functioning" (Rogers, 2008, p. 2-509).

## Methods

A search of relevant literature included the following databases: Cumulative Index of Nursing and Allied Health Literature, PubMed and PsycInfo. Key terms fatigue and nurse, along with one other term such as occupational safety, patient safety, job performance, medication errors, shift work, workload, and sleep deprivation were searched individually and in a Boolean search with the term AND for several combinations. A search of the Cochrane library using the same search terms failed to identify any additional research studies on the chosen topic.

Inclusion criteria included 1) studies published in peer-reviewed journals; 2) written in English; 3) examining nurse work schedules (specifically 12-hour shifts); 4) and the effects of acute work-related fatigue on nurses' ability to provide safe care. Exclusion criteria included non-research articles; studies focusing on alarm, compassion, chronic, or change fatigue; and studies focusing on healthcare providers who were not bedside nurses.

A total of 77 articles were discovered across all databases searched. Fourteen articles met inclusion criteria. Manual searches of article references provided an additional nine studies, for a total of 23 studies included in the review (see Table 1). Within the 23 articles, there was one level II study (Smith-Coggins et al., 2006), one level III study, eleven level IV studies, and ten level VI studies. A level II study is a randomized control trial (RCT). A level III study is a controlled trial that lacks randomization. A level IV study is a case-control or cohort study, and a level VI study is a single descriptive or qualitative study (Melnyk & Fineout-Overholt, 2011).

## Discussion

Fatigue affects nurses physically and mentally. Physically, fatigue has been implicated in the development of obesity, hypertension, stroke, elevated glucose levels, and metabolic syndrome (Geiger-Brown et al., 2012). Mentally, fatigue has been associated with decreased alertness and concentration. It negatively affects mood (Barker & Nussbaum, 2011), vigilance, decision-making, and reaction times (Hazzard et al., 2013).

Diminished mental processing accompanied by fatigue can have a profound impact on patient safety. Research established a relationship between fatigue and errors

or near errors. The majority of errors or near errors involved administration of the wrong medication or the wrong dose of medication (Olds & Clarke, 2010; Edwards, McMillan, & Fallis, 2013). Some of the errors or near errors were related to procedures, charting, and transcription (Rogers, Hwang, Scott, Aiken, & Dinges, 2004; Scott et al., 2006), mislabeled blood samples (Edwards et al., 2013), and medication errors (Rogers et al., 2004).

In a study of 8- and 12-hour shift Australian nurses, Dorrian et al. (2008) discovered errors, near errors and errors caught by one nurse but made by another nurse included medical, transcription, charting, and procedures. Most errors occurred in the morning, while most of the errors caught by one nurse but made by another nurse occurred in the evening and episodes of struggling to stay awake and near miss accidents occurred for night shift nurses. Struggling to stay awake at work, exhaustion and the number of consecutive shifts worked were common factors among nurses who experienced near miss accidents while traveling home after work. Shift length, amount of sleep obtained throughout the preceding 24 hours and exhaustion ratings were found to be predictors for struggling to stay awake at work.

With studies revealing the effects of long shifts and fatigue on patient safety, Trinkoff, Geiger-Brown, Brady, Lipscomb, and Muntaner (2006) examined the schedules of nurses from a variety of work settings. They found hospital nurses were more likely to work 12-hours or more per day, more than one job, and more consecutive days.

In recent years, the number of hours worked, resulting level of fatigue, and their combined effect on patient and nurses' personal safety have been recognized. The more hours one worked, the greater the level of fatigue (Barker & Nussbaum, 2011; Olds &

Clarke, 2010; Rathore, Shukla, Singh, & Tiwari, 2012). According to Bae (2013) patient safety is jeopardized because nurses' work-related fatigue increases the risk for patient falls (OR=2.66, CI=1.09-6.50, $p<0.01$), development of pressure ulcers (OR=4.32, CI=1.70-11.00, $p<0.01$), and the acquisition of nosocomial infections (OR=4.91, CI=1.99-12.12, $p<0.01$). Olds and Clarke (2010) reported that nurses who work more than twelve hours are at greater risk of sustaining needle sticks (OR 1.014, $p=0.002$). The risk of sustaining needle stick injuries is also supported by Edwards et al. (2013), and Trinkoff, Rong, Geiger-Brown, and Lipscomb (2007).

Working more than twelve hours also revealed an increased risk for nurses to experience musculoskeletal injuries (Lipscomb, Trinkoff, Geiger-Brown, & Brady, 2002; Edwards et al., 2013), vehicular accidents and near-miss vehicular accidents while driving home from work (Johnson, et al., 2010; Scott, Hofmeister, Rogness, & Rogers, 2010a; Scott, et al., 2007). Having worked 12-hour shifts for more than twenty years, the principal investigator was aware that a 12-hour shift frequently becomes a 13- or 14-hour shift. Research shows working more than 12 consecutive hours triples the likelihood of making a mistake (Barker & Nussbaum, 2011).

To gain a better understanding of nursing activities that significantly contribute to nurses' acute work-related fatigue, Chen, Daraiseh, Davis, and Pan (2014) recorded nurses' working heart rates throughout their shift. Manual patient handling was found to be the most strenuous nursing activity, however, it is not required often throughout a shift. Other nursing activities that contributed to nurses' acute work-related fatigue included bedside care, care coordinating, and walking and standing. Nurses experienced higher heart rates and consumed a significant amount of energy when standing to chart

compared to charting while sitting.

Despite the evidence numerous studies have revealed that 12-hour shifts have a negative effect on patient and nurses' personal safety, many nurses today continue to work 12-hour shifts (Townsend, 2013). This work schedule may appeal to nurses because it can allow them to be home at least four days a week providing them more time with family and friends (McGettrick & O'Neill, 2006). Eliminating 12-hour shifts may decrease nurse satisfaction and thereby potentially impact retention negatively (Montgomery & Geiger-Brown, 2010). As a result, the cost of nurse recruitment and orientation could increase if more nurses need to be hired to fill vacant positions.

Determining interventions to combat acute work-related fatigue are needed. Chen, Davis, Daraiseh, Pan, and Davis (2014) found nurses who exercised weekly experienced significantly less fatigue, and had better fatigue recovery ($t_{128} = -2.884$, $p = 0.005$) compared to nurses who did not exercise. In addition to exercise, napping is another intervention that can be used to reduce acute work-related fatigue (Smith-Coggins et al., 2006). In a study conducted by Edwards et al. (2013), 55% of nurse managers indicated they approved of staff napping. Nurse managers acknowledged benefits to napping including improved alertness, reaction time, decision making ability, and safer driving on the commute home. In addition to increases in nurses' personal safety, the benefits of napping improved patient safety. Despite approving of naps and knowing the benefits nurses obtained from napping, only 11% of nurse managers had a space designated for napping. Nurses also acknowledged the benefits of napping such as improved mood, energy level, clearer judgment, and reaction time (Edwards et al., 2013).

Despite the benefits napping provided, nurse managers voiced concerns

related to naps including the length of naps, post nap inertia, and the lack of a dedicated space for napping. Concern about experiencing post nap inertia lead some staff nurses to decide against napping while working. Nurse managers also reported that 96% of senior leadership were not in favor of napping (Edwards et al., 2013).

## Future Research

Future research in this area is needed. Barker and Nussbaum (2011) recommended studies to quantify nurses' fatigue levels in a variety of work environments, and interactions between shift length, shift schedules, and fatigue levels. Scott et al. (2010a) encouraged examination of the "acceptability, efficacy, and effectiveness of a fatigue countermeasures program for nurses" (p. 257).

Johnson et al. (2010) recommended investigating the impact sleep deprivation and poor psychomotor performance have on nursing practice and studying the use of physiologic methods to measure sleep. They also recommended comparative studies between performances of sleep deprived nurses working on low acuity units to nurses working on high acuity units, as well as a comparison of rotating shifts and their impact on psychomotor performance. Finally, Johnson et al. (2010) recommended a study evaluating the length of shift and its impact on nurses' ability to obtain adequate sleep.

Olds and Clarke (2010) recommended examining the impact of overtime on nurse and patient safety. Geiger-Brown et al. (2012) recommended developing methods to assess nurses' fitness for duty when sleep deprived, and a study to evaluate the effects of education and scheduling interventions such as naps on the quantity and quality of sleep for nurses who work 12-hour shifts. Kunert, King, and Kolhorst (2007) recommended a study to determine interventions to decrease fatigue and improve sleep quality for shift

work nurses. Fallis, McMillian, and Edwards (2011), and Edwards et al. (2013) recommended studies to examine naps, and the effect of sleep inertia.

Ruggiero, Redeker, Fiedler, Avi-Itzhak, and Fischetti (2012) recommended studying circadian rhythm characteristics of sleep, sleepiness and reaction time. Richardson, Turnock, Harris, Finley, and Carson (2007) recommended comparing shift patterns and nurses' level of fatigue while Chen et al. (2014) suggested studying work breaks, and time off between shifts to determine their effect on nurses' working heart rate.

In addition to the recommended studies listed above, strategies to combat fatigue are needed. Some suggested strategies include teamwork (Estryn-Behar, Van der Heijden, and the NEXT Study Group, 2012; Hazzard et al., 2013); breaks free from patient care (Hazzard et al., 2013; Johnson et al. 2010; Scott et al., 2010a; Scott et al., 2010b); educating nurses on interventions to improve their sleep (Johnson et al., 2010); scheduling nurses to nap for a period of time during their shift (Fallis et al., 2011; Scott et al., 2010a; Scott et al., 2010b); and regular exercise (Chen et al., 2014). In order to successfully implement naps as an intervention to combat fatigue, a study involving hospital administrators and managers is needed to determine the support for and identify the barriers to supporting the use of naps by nurses to combat acute work-related fatigue (Edwards et al., 2013).

## Conclusion

The aim of this paper was to identify research studies about nurses' acute work-related fatigue, its impact on patient safety as well as nurses' personal safety, interventions for combating acute work-related fatigue, and recommendations for future

research on nurse acute work-related fatigue. Studies were presented addressing all three of these areas. Many hospital nurses work 12-hours shifts, and many hospital nurses experience acute work-related fatigue. Knowing the potential impact acute work-related fatigue has on patients and nurses, it would seem logical to discuss enforcing a shorter shift length. However, the benefits 12-hour shifts provide to nurses and hospital nurse managers and administrators, make 12-hour shifts appealing despite their potentially ill effects. With that in mind, strategies to combat or prevent acute work-related fatigue must be developed, tested, and implemented to ensure the safety and well-being of both patients and nurses.

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Table 1

*Table 1. Summary of Nurse Fatigue Studies*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Barker and Nussbaum (2011). U.S. | 745 Registered Nurses<br>Cross-Sectional Survey<br>Level VI | • Correlation between fatigue and shifts greater than eight hours<br>• Mental fatigue affects concentration, mood, and mental energy, decreasing vigilance.<br>• Extended work hours increases likelihood of injuries, increased fatigue, decreases in performance and reaction time. |
| Chen, Daraiseh, Davis, and Pan (2014) U.S. | 8 Registered Nurses<br>Non-experimental, Observational<br>Level IV | • Nurses' time: 54% indirect care activities, 24% direct patient care, 21% breaks.<br>• Manual patient handling, bedside care, walking, and standing activities produced significant levels of acute fatigue.<br>• Manual patient handling most strenuous activity, but only small portion of shift spent on this task.<br>• Nurses experience elevated heart rate (HR) due to working in awkward positions and mental stress secondary to the cognitive demands required for multitasking.<br>• Walking significant distances during the work shift increases fatigue levels.<br>• Standing while charting increases nurses' HR leading to fatigue.<br>• Compared to first shift, nurses had higher HR while working second shift leading to increased fatigue levels. |
| Chen, Davis, Daraiseh, Pan, and Davis (2014) U.S. | 130 Registered Nurses<br>Cross-Sectional Descriptive<br>Level VI | • Correlation between acute fatigue and working 12-hour dayshift.<br>• Nurses working in a magnet hospital experienced less acute fatigue than nurses working in non-magnet hospitals. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Dorrian, Tolley, Lamond, van den Heuvel, Pincombe, Rogers, and Drew (2008)<br>Australia | 41 Registered Nurses<br>Non-experimental<br>Quantitative<br>Level IV | • Nurses struggle to stay awake during 32% of shifts.<br>• Nurses reported episodes of drowsy driving or cycling home<br>• Half of the drowsy incidents occurred between 7 and 9 A.M.<br>• Additional 40% of extreme drowsiness and near accident episodes occurred between 2 and 7 P.M.<br>• Total sleep length was significantly shorter on workdays and shifts where errors were reported ($p<0.05$).<br>• Stress and struggling to stay while working were significantly associated with errors including medical, transcription, charting, procedural, slips and falls.<br>• Nurses who struggled to stay awake while working were 2.5 times more likely to make an error.<br>• Exhaustion, struggling to remain awake while working, and number of consecutive shifts were significantly associated with extreme drowsiness and near accidents traveling home from work. |
| Edwards, McMillan, and Fallis 2013<br>Canada | 47 Canadian Critical Care Unit Managers<br>Nonexperimental<br>Quantitative<br>Level IV | • 40% of nurse managers were aware of night shift nurse fatigue that led to medication errors, mislabeled blood samples, calculation errors, and miss orders.<br>• Managers reported fatigue being a component of work-related injuries including needle sticks, injuries from lifting incorrectly.<br>• Managers reported being aware of staff who had fallen asleep while driving home from work, driving through red lights, driving off the road, and being involved in motor vehicle accidents and near accidents with pedestrians or other vehicles.<br>• Manager approval of napping during break time to relieve fatigue varied. |
| Estryn-Behar, Van der Heijden, and the NEXT Study Group (2012)<br>Europe | 25,924 nurses<br>Quantitative<br>Level IV | • Nurses working 12-hour shifts were concerned about making a mistake, and reported low quality of teamwork.<br>• Nurses working rotating shifts or 12-hour shifts reported high physical workloads.<br>• Nurses who worked 12-hour shifts had poorer health than those who worked 8-hour shifts.<br>• Nurses who worked 10-12 hour day shifts or 12-hour night shifts experienced more fatigue and burnout.<br>• Working more than eight hours doubled the risk of having an accident.<br>• Every hour worked beyond 40 hours, increased the risk of a nurse making a medication error, or experiencing a needle stick injury. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Fallis, McMillan, and Edwards (2011)<br>Canada | 13 Registered Nurses<br>Qualitative, Descriptive<br>Level VI | • Majority of nurses reported taking a nap during their shifts when staffing, and unit needs allowed.<br>• After napping, nurses reported feeling energized or refreshed, having a better mood, and clearer judgment.<br>• Some nurses reported feeling disoriented upon awakening from a nap.<br>• Those who regularly napped, when unable to do so, reported feeling mentally slow, and uncertain about their clinical judgment, irritable, lacking energy, and concerned about safety.<br>• Many nurses expressed concern about driving home.<br>• One nurse reported driving through a red light, and being unable to recall driving home.<br>• Many nurses indicated naps were not supported by management. |
| Geiger-Brown, Rogers, Trinkoff, Kane, Bausell, and Scharf (2012)<br>U.S. | 80 Registered Nurses<br>Non-experimental, Quantitative<br>Level IV | • Nurses working 12-hour shifts did not obtain adequate amounts of sleep between shifts to physically and cognitively recover.<br>• Nurses were sleepier by the end of their third consecutive 12-hour shift compared to their previous two 12-hour shifts.<br>• Nurses working night shift were sleepier than nurses that worked 12-hour day shift.<br>• Errors occurred more frequently after working 12 hours compared to the start of the 12-hour shift.<br>• Nurses reported high fatigue levels.<br>• Most nurses slept less than 6 hours between 12-hour shifts.<br>• Limited sleep between shifts affected performance due to episodes of inattention.<br>• Nurses rely on caffeine to maintain alertness and mental performance. |
| Kunert, King, and Kolhorst (2007)<br>U.S. | 90 night shift Registered Nurses and 100 day shift Registered Nurses<br>Non-experimental, Quantitative study<br>Level IV | • Night shift nurses experience higher levels of fatigue, and poorer sleep quality and duration, use more sleeping medication, and experience more daytime dysfunction compared to day shift nurses. |
| Lipscomb, Trinkoff, and Geiger-Brown (2002)<br>U.S. | 1091 Registered Nurses<br>Single descriptive study<br>Level VI | • Working more than 12 consecutive hours per day along with more than 40 hours per week significantly increased the odds ratio of experiencing musculoskeletal problems in the neck, back, and shoulder. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| McGettrick and O'Neill (2006)<br>England | 54 nurses in Phase 1<br>6 nurses in Phase 2<br>Level VI | • Nurses identified the benefits of 12-hours shifts including greater flexibility, more time off work, more time at home, better quality family life, improved patient care, continuity with patients and their families, more time to plan care.<br>• Some nurses reported feeling too tired from working 12-hour shifts. |
| Olds, and Clarke (2010)<br>U.S. | 11,516 Registered Nurses<br>Non-experimental, Quantitative<br>Level IV | • More than 5,000 nurses reported working overtime<br>• 9.6% indicated they had suffered a needle stick or sharps injuries.<br>• Nurses reported adverse events including wrong medication or wrong dose of medication, patient falls with injury, work injuries, and nosocomial infections.<br>• Frequency adverse events was significantly higher when nurses worked more than 40 hours per week.<br>• Voluntary overtime was associated with medication errors and needle stick injuries.<br>• For every one hour of overtime worked, the likelihood of committing a medication error increased 2%.<br>• Working more than four hours of overtime was associated with a 30% increased likelihood of making a medication error.<br>• Working 3 hours of overtime, increased the likelihood of sustaining a work related injury 3%, and the likelihood of a needle stick injury 4.3%.<br>• Medication errors may be due to a decrease in vigilance as a result of fatigue. |
| Rathore, Shukla, Singh, and Tiwari (2012)<br>India | 60 Nurses<br>Qualitative<br>Level VI | • Nurses working 12-hour shifts experience greater levels of fatigue than those that work 8- hour shifts. |
| Richardson, Turnock, Harris, Finley, and Carson (2007)<br>England | 147 members of nursing staff<br>Qualitative<br>Level VI | • Noted benefits of working 12-hour shifts.<br>• Staff were "tired" at the end of 12-hour shifts.<br>• Staff felt they should not work more than three consecutive day shifts or more than four consecutive night shifts due to safety concerns.<br>• Staff believe 48 hours off is needed when rotating from night shift to day shift. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Rogers, Hwang, Scott, Aiken, and Dinges (2004) U.S. | 393 hospital staff nurses Non-experimental, Quantitative Level IV | • Work duration, overtime, and number of hours worked per week had a significant effect on errors (medication, procedural, charting, and transcription).<br>• When shift was 12.5 hours or more, risk of making an error was three times higher (odds ratio = 3.29, p=.001).<br>• The risk of making at least one error increased when working overtime.<br>• Risk for making an error also increased when nurses work more than 40 hours per week. |
| Scott, Arslanian-Engoren, and Engoren (2014) U.S. | 605 Critical Care Nurses Nonexperimental, Descriptive Level VI | • 157 nurses, many of whom work night shift or 12-hour shifts, reported decision regret.<br>• Those who reported decision regret were more likely to experience acute fatigue, daytime sleepiness, less intershift recovery, and poor sleep quality. |
| Scott, Hofmeister, Rogness, and Rogers (2010) U.S. | 47 Staff Nurses One group pretest-posttest repeated measure Level III | • After attending a fatigue countermeasures program, nurses slept longer, getting the most sleep on days off from work.<br>• Nurses had fewer episodes of drowsiness.<br>• Before attending the fatigue countermeasures program, nurses reported 92 episodes of drowsy driving and 5 motor vehicle accidents or near accidents.<br>• Three months after attending the program, episodes of drowsy driving decreased 27%, and motor vehicle accidents decreased 80%.<br>• During the study, 117 errors or near errors involving medication administration, patient care procedures, physician order processing and transcription were reported while 72 errors were prevented or were discovered by nurses.<br>• After attending the fatigue countermeasures program, error and near error rates decreased while prevented or discovered errors increased. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Scott, Hofmeister, Rogness, and Rogers (2010)<br>U.S. | 46 hospital staff nurses and 8 nurse managers<br>Qualitative<br>Level VI | • Benefits of a fatigue countermeasures program for nurses identified by nurses included awareness of sleep needs, physical feelings related to caffeine consumption, and the importance of mental rest.<br>• Nurses working night shift developed a better understanding of how to manage fatigue.<br>• Nurses that implemented strategies learned from the fatigue countermeasures program felt more rested, vigilant and organized while providing patient care.<br>• Many nurses took control of their sleep environment by removing sleep disruptors (pets) and distractors (television sets) which increased their sleep duration and quality.<br>• Nurses' reasons for the inability to nap during a work shift included inadequate sleep rooms, sleep rooms located to far from the unit, feeling guilty about napping while co-workers were working, and lack of trust in co-workers.<br>• Nurse managers believe the fatigue countermeasures program for nurses improved nurses' overall health since they were engaging in healthy behaviors.<br>• Nurse managers indicated obtaining space for staff to rest was challenging.<br>• Nurse managers voiced concern that nurses did not consider breaks a priority. |
| Scott, Hwang, Rogers, Nysse, Dean, and Dinges (2007)<br>U.S. | 895 Registered Nurses<br>Quantitative<br>Level IV | • Risk of drowsy driving doubled when work shift lasted 12.5 consecutive hours or more (OR=2.00; P<0.0001).<br>• Nurses who struggled to stay awake while working were three times as likely to experience drowsy driving on the home from work (OR=3.37, P<0.0001). |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Scott, Rogers, Hwang, and Zhang (2006)<br>U.S. | 502 Registered nurses<br>Descriptive, Exploratory study<br>Level VI | • Nurses work longer than scheduled on a regular basis.<br>• 50% of shifts exceeded 12 hours.<br>• 54 nurses worked >16 hours, 1 reported working at least 16 hours on 6 different occasions.<br>• Nurses were often scheduled to work 16 hours or more.<br>• Nurses left work on time only 13% of the time.<br>• On average, nurses worked an extra 49 minutes per shift.<br>• Mandatory overtime was common.<br>• Nurses reported feeling coerced to work overtime 10.5% of the time.<br>• Episodes of drowsiness and falling asleep at work were NOT confined to night time hours.<br>• 40% of drowsiness and 23% of sleep episodes occurred between 6 AM and midnight.<br>• Nurses working more than 12.5 consecutive hours struggle to stay awake.<br>• The risk of falling asleep at work almost doubled when shifts exceeded 8 hours ($p=0.04$).<br>• Risk of falling asleep at work increased even more when working more than 12 hour shifts ($p=0.01$).<br>• The risk of making an error (medication, procedural, charting or transcription) almost doubled when nurses worked $\geq$12.5 hours ($p=0.03$).<br>• Working more than 40 hours/week had a significant effect on errors and near errors ($p<0.001$).<br>• Longer shifts increased the risk of error, and were associated with decreased vigilance. |
| Smith-Coggins et al. (2006)<br>U.S. | 49 resident physicians and Registered Nurse<br>RCT<br>Level II | • Residents and nurses assigned to nap had fewer lapses, reacted more quickly, performed an intravenous insertion faster, had increased alertness while driving, reported less fatigue, and less sleepiness than those without a nap. |

*Table 1. Summary of Nurse Fatigue Studies (Continued)*

| Study Author, Date, Location | Sample, Method, Level of Evidence[a] | Findings |
|---|---|---|
| Trinkoff, Geiger-Brown, Brady, Lipscomb, and Mutaner (2006) U.S. | 2,273 Registered Nurses<br>Non-experimental Quantitative study<br>Level IV | • 52% of nurses were more likely to work 12 or more hours a day.<br>• Only 2.6% of nurses would work six or seven days a week.<br>• Nurses with more than one job were more likely to work 12 or more hours a day (37%).<br>• 9% of nurses worked 13 or more consecutive days without a break, and sufficient rest (14% worked with less than 10 hours off between shifts at least once a week) and during scheduled time off (13%).<br>• Schedules of single parents with children, were similar to parents working more than 1 job, working 13-15 or more hours per day, 50-60 hours per week, and numerous days in a row. They were more likely to work off shifts, and with less than 10 hours off between shifts. Twenty-four percent had jobs that included mandatory overtime.<br>• Nurses 50 or more years of age were least likely to work long days. Majority of these nurses worked day shift.<br>• More than forty percent of hospital staff nurses' positions include on-call with 22% being called in to work monthly, 12% weekly, and 7% more than once a week.<br>• Despite long hours, nurses took few breaks.<br>• Eleven percent of nurses not taking breaks during their shift.<br>• Nurses who worked mandatory overtime worked significantly longer hours (Pearson $X^2$ =15.64, with 3 df, p=0.004).<br>• Jobs requiring on-call hours were significantly more likely to have mandatory overtime ($p<0.0001$).<br>• 17% of nurses exceeded the Institute of Medicine's proposed work-time guidelines on a regular basis. |
| Trinkoff, Geiger-Brown, Rong, and Lipscomb (2007) U.S. | 2624 Registered Nurses<br>3 wave Longitudinal Study<br>Level IV | • Working more than 13 hours per day, off shifts, weekends, and less than 10 hours off between shifts were significantly associated with needle stick injuries ($p<.001$). |

*Note:* [a]Levels of Evidence defined: Level II RCTs; Level III Controlled trial without randomization; Level IV Case-control or Cohort studies; Level VI Single descriptive or qualitative studies (Melnyk and Fineout-Overholt, 2011).

Chapter Three

# Impact of Nurse Fatigue and Nursing Handoffs on Patient and Nurse Safety


## Abstract

Objective: To determine differences between 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) nurses' personal safety among maternal newborn (MN) nurses who worked 8- versus 12-hour shifts.

Participants: A random sample of 221 MN nurses who worked 8- or 12-hour shifts in an acute care setting was recruited February through April 2016 to participate in this study.

Methods: In a cross-sectional study using Qualtrics, a web-based online software program, participants completed a survey that measured handoff quality, nurse accidents and injuries, errors, and work-related fatigue. Statistical analyses included independent samples *t*-test and multiple regression.

Results: Compared with nurses who worked 8-hour shifts, those who worked 12-hour shifts reported a) more fatigue ($p = .02$); b) more patient errors including medication and near errors; and c) more work-related injuries and accidents. There was no difference in handoff quality between the two groups. Fatigue and ineffective handoffs were significant predictors of patient errors ($p = .000$) and near errors ($p = .02$).

Conclusion: This study supports previous evidence that 12-hour shifts can have a negative impact on patient and nurse safety. Hospital administrators should consider the growing body of evidence that supports reevaluation of 12-hour shifts for bedside nurses.



*Keywords*: work-related fatigue, handoff, safety, errors, hospital environment

Nurses are caring for patients who are often sicker than they were in the past (American Hospital Association, 2012; Elliott & Coventry, 2012; Ryan, Cadman, & Hann, 2004), requiring heightened levels of surveillance and vigilance, yet a patient's length of stay is shorter than in previous years. There is also a shortage of nurses. According to the United States (U.S.) Bureau of Labor Statistics (2014), between now and 2022 an additional 1.1 million registered nurses (RNs) will be needed to meet the demands for healthcare and to replace older nurses as they retire. In 2014, hospital vacancy rates for RN were 16.5%, and RN turnover rates were 14.2%, with those working in Medical-Surgical areas experiencing the highest turnover at 24% (Nursing Solutions, 2014). Caring for sicker patients who are in the hospital for shorter lengths of time and the nursing shortage has increased the workload for nurses. In addition to heavier workloads, seventy-five percent of nurses work 12-hour shifts (Townsend, 2013). All of these factors can contribute to work-related fatigue, which may negatively affect nurses' personal safety as well as patient safety (Carayon & Alvarado, 2007; Carayon & Gurses, 2008).

In addition to work-related fatigue, nursing handoffs can potentially compromise patient safety. During nursing handoff, responsibility for patient care is transferred from one nurse to another. It is also during handoff that critical information about the patient is passed from one nurse to another.

Nursing handoffs occur in a variety of settings, including some settings where interruptions occur frequently. For example, the method of handoff may vary from one nursing unit to another. On occasion, these variations have been shown to lead to omissions of important patient information (Friesen, White, & Byers, 2008; O'Connell,

MacDonald, & Kelly, 2008) that "can cause serious breakdowns in the continuity of care, inappropriate treatment, and potential harm to the patient" (World Health Organization, 2007, p. 1). As a result, there have been numerous recommendations to standardize the handoff process in an effort to improve the communication of critical patient information between nurses thereby reducing the risk of harm to patients (Friesen, White, & Byers, 2008; Streitenberger, Breen-Reid, & Harris, 2006; Taylor, 2015; World Health Organization, 2007). The purpose of this study was to determine the differences between 8- and 12-hour shifts related to 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) work-related fatigue and Maternal newborn (MN) nurses' personal safety.

## Literature Review

### Nurse Work-Related Fatigue

Nurses who work three 12-hour shifts per week can experience fatigue associated with "lapses in attention and inability to stay focused, reduced motivation, compromised problem solving, confusion, irritability, memory lapses, impaired communication, slowed or faulty information processing and judgment, diminished reaction time, and indifference and loss of empathy" (The Joint Commission, 2011, p. 1). Fatigue affects nurses physically and mentally. Physically, it has been implicated in the development of obesity, hypertension, stroke, elevated glucose levels, and metabolic syndrome (Geiger-Brown et al., 2012). Furthermore, Barker and Nussbaum (2011) found mental fatigue was "most strongly negatively correlated" with changes in concentration, mood, and mental energy (p. 1378). Mental fatigue also decreases vigilance, decision-making, and reaction times (Hazzard et al., 2013).

## Impact of Fatigue

Nurses' work-related fatigue can have a negative effect on patients' safety and nurses' personal safety. The results of previous studies examining nurses' work-related fatigue, and the impact on patients' safety and nurses' personal safety are presented in this section.

***Patient safety.*** Researchers have demonstrated that diminished mental processing due to fatigue can have a profound impact on patient safety. Furthermore, researchers have established a relationship between fatigue and errors or near errors. The majority of errors or near errors involved administration of the wrong medication or the wrong dose of medication (Olds & Clarke, 2010; Edwards, McMillan, & Fallis, 2013). Some of the errors or near errors were also related to procedures, charting, transcription of physician orders (Scott, Rogers, Hwang, & Zhang, 2006), and mislabeled blood samples (Edwards et al., 2013).

In recent years, the combined effect of shift length and work-related fatigue on patients' and nurses' personal safety has been recognized. Overall, researchers have found that the more hours worked, the greater the level of fatigue. Barker and Nussbaum (2011) found longer shifts and more hours worked per week were associated with increased levels of physical and total fatigue. This could interfere with vigilance, alertness and reaction time affecting a nurse's ability to detect adverse changes in patients, delaying treatment, and averting complications (Trinkoff et al., 2011). Rogers, Hwang, Scott, Aiken, & Dinges (2004) found that in their sample working more than 12 consecutive hours can tripled the likelihood of making a mistake (OR 3.29, p=.001). Olds and Clarke (2010) reported working three hours of overtime was associated with a 3.6%

increased risk of making a medication error. According to Bae (2013) nurses' work-related fatigue hindered vigilance and alertness increasing the risk for patient falls (OR=2.66, CI=1.09-6.50, p<0.01), the development of pressure ulcers (OR=4.32, CI=1.70-11.00, p<0.01), and the acquisition of nosocomial infections (OR=4.91, CI=1.99-12.12, p<0.01).

***Nurse safety.*** Working more than twelve hours per day may increase nurses' personal risk for musculoskeletal injuries (Trinkoff et al., 2008; Edwards et al., 2013), vehicular accidents and near-miss vehicular accidents while driving home from work (Johnson, Brown, & Weaver, 2010; Scott, Hofmeister, Rogness, & Rogers, 2010; Scott et al., 2007). Frequently, a 12-hour shift can become a 13- or 14-hour shift (Trinkoff, Geiger-Brown, Brady, Lipscomb, & Mutaner, 2006). Working more than three hours of overtime increased the risk of a nurse sustaining a work-related injury by 3% (OR 1.010, p=0.013), and the risk of sustaining a needle stick injury by 4.3% (OR 1.014, p=0.002) (Olds & Clarke, 2010). The increased risk of sustaining needle stick injuries was also supported by Edwards et al. (2013). Previous research has highlighted the negative impact fatigue may have on nurses' personal safety.

**Length of Shift**

Even though numerous studies have revealed the negative effects12-hour shifts can have on patient and nurses' personal safety, many nurses today continue to work 12-hour shifts (Townsend, 2013). This work schedule may appeal to nurses because it can allow them to be home at least four days a week providing them more time with family and friends. Eliminating 12-hour shifts may decrease nurse satisfaction and thereby potentially negatively impacting retention (Montgomery & Geiger-Brown, 2010). As a

result, the cost of nurse recruitment and orientation could increase because more nurses would be needed to fill vacant positions.

The majority of studies examining the effects of 12-hour shifts on patients' and nurses' personal safety collected data from nurses working in medical-surgical nursing units, intensive care units, post-anesthesia care units, or emergency departments. Only a few studies included MN nurses. No studies focused only MN nurses. MN nurses are trained to care for both low- and high-risk pregnant women before, during and after delivery. They are also trained to care for low- and high-risk newborns. In labor and delivery units, nurses are in the unique position of caring for two patients, one they cannot physically touch until after delivery. During pregnancy, labor, and delivery numerous events can occur that may lead to an adverse outcome. MN nurses need to be alert and vigilant for signs of complications before, during, and after delivery so timely interventions can be initiated to avert such an outcome.

According to CNA HealthPro and Nurses Service Organization (2011), professional liability insurance companies, among 3,222 claims filed from 2006-2010, only 10.3% of total claims involved nurses who worked in maternal newborn health but the average payment was greater than $350,000, more than twice the average payment of any other nursing specialty. The most severe allegations involved scope of practice, assessment, monitoring, treatment and care management, and medication administration. Studying MN nurses to determine how the shift length and associated adverse events affect patients' safety and nurses' personal safety could provide information MN nurses could use to improve outcomes and reduce subsequent liability.

## Nursing Handoffs

Nursing handoffs occur at shift change, when a patient is transferred from one hospital unit to another, and when a patient is transferred from one hospital to another hospital. Even though nursing handoffs occur at each of these times, as well as for breaks and meals, this study will focus exclusively on nursing handoffs that occur at shift change because after handoff, the off going nurse is no longer on duty and may be unreachable if questions were to arise due to incomplete handoff of important patient information. If questions arise after handoff that occurred due to a meal or break, the primary nurse is typically still in the facility and can be reached so questions can be addressed. Nursing handoff is a time for relevant patient information including history, current physical examination, medications, treatment plans, care plans, and physician's orders to be reviewed with the oncoming nurse. However, during nursing handoffs, not all relevant patient information may be communicated. For example, lack of communication during handoffs has often been found to be a contributing factor when errors and near errors occur (Ebright, Urden, Patterson, & Chalko, 2004; Friesen et al., 2008; Riesenberg, Leitzsch, & Cunningham, 2010). The Joint Commission (2015) revealed that communication (oral, written, electronic, among staff, with/among physicians, with administration, with patient or family) was a root cause in 63% of sentinel events in 2013, 64% of sentinel events in 2014, and 72% of sentinel events for the first two quarters of 2015.

The number of nursing handoffs required are determined by the length of shift. When nurses work 12-hour shifts, there are only two shift changes, and, therefore, two handoffs each day related to shift change. When nurses work 8-hour shifts, the number

of handoffs increase to three each day. The increase in the number of patient handoffs required when working 8-hour shifts may lead to an increase in errors, which could compromise patients' safety.

## Theoretical Framework

The theoretical framework guiding this study is the Hospital Nurse Force Theory (Drake, Luna, Georges, & Steege, 2012, Figure 1). This theory focuses on nurses who work in acute care hospitals. According to the theory, the demands of hospital work may lead to nurse work-related fatigue, which can lead to errors that can ultimately harm patients and also impact nurses' personal safety. The major components of this theory that are important to this study are nurse fatigue, hospital environment, patient and nurse harm.

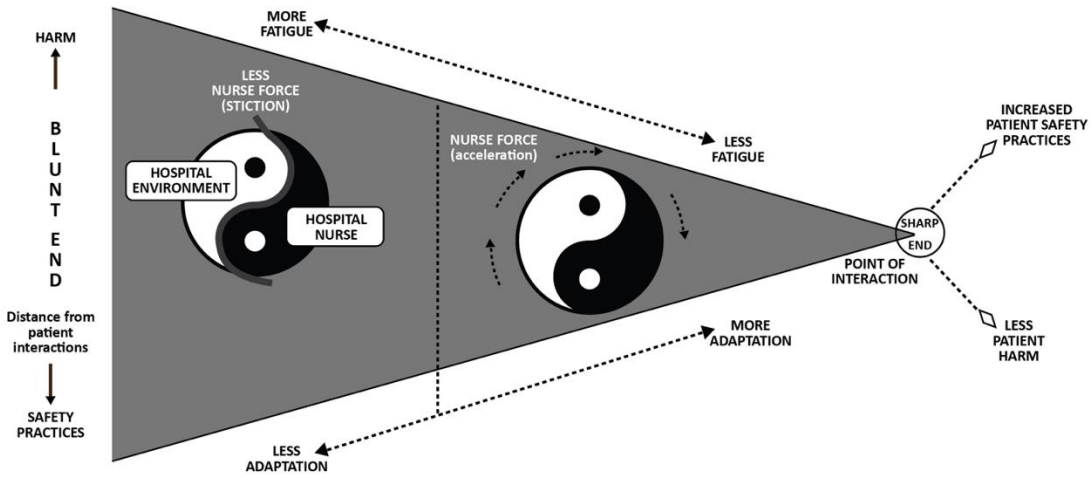


*Figure 1. Hospital Nurse Force Theory*
From "Hospital Nurse Force Theory: A Perspective of Nurse Fatigue and Patient Harm," by D. Drake, M. Luna, J. Georges, and L. Steege, 2012, *Advances in Nursing Science, 35*(4), 305-314. Copyright 2013 by Wolters Kluwer Health. Reprinted with permission.

Nurse fatigue is described as "inadequate adaptation and restoration of work energy" (Drake et al., 2012, p. 308). Fatigue can be physical, mental, emotional, social,

and spiritual. Each type of fatigue can be harmful to patients and nurses and can negatively impact nurse force and nurse wellness. According to Drake et al. (2012), nurses need energy (nurse force) in order to provide care. Nurse wellness is multidimensional including physical, mental, emotional, social and spiritual. Throughout an 8- or 12-hour shift, nurses need to be able to work, learn, cope, interact with others, and make decisions. Fatigue can leave nurses without the energy needed to care for patients, and can render them unable to make clear, decisive decisions. Certain shifts, specifically 12-hour shifts, evening, night, and rotating shifts, can result in increased levels of nurse fatigue (Barker & Nussbaum, 2011). According to the theory, the hospital environment may decrease nurse force (energy) leading to greater levels of nurse fatigue, which can negatively affect patient safety, and nurses' personal safety.

For the purpose of this study, shift length, 8-hours and 12-hours, and number of nursing handoffs were viewed as part of the hospital environment. Upon hire, nurses are typically offered to work either 8- or 12-hour shifts. Shift length determines the number of handoffs per day. The increase in the number of patient handoffs required when nurses work 8-hour shifts may lead to an increase in errors and potential harm to patients.

In many facilities, nurse staffing is based on budgeted hours per patient day; not patient acuity (Nguyen, 2015; Powell & Fogel, 2013; Sherman, Martinez-Soto, Peters, Mathew, & Pischke-Winn, 2010). As a result, nurses may be assigned to care for several patients with high acuity. Patients with high acuity levels are typically sicker requiring a greater amount of nursing care. When assigned to care for several high acuity patients, nurses may neglect their own needs, such as breaks and meals, as they strive to meet the needs of their patients (Rogers, Hwang, & Scott, 2004). It is feasible that missing breaks

and meals may increase fatigue levels, which could lead to errors that affect patient safety and nurses' personal safety. According to the theory, the hospital environment, including shift length, staffing, patient acuity, and missing breaks and meals, would be expected to lead to more fatigue, thereby increasing the risk of harm for patients and injuries for nurses. The theoretical relationships among the concepts of nurse fatigue, hospital environment, patient and nurse harm will guide the expected relationships among study variables (see Figure 2). Expected relationships include changes in work-related fatigue associated with shift length (specifically longer shift lengths), errors (patient) associated with work-related fatigue and nursing handoffs miscommunication, errors, and accidents/injuries (nurse) associated with shift length (specifically 12-hour shifts).

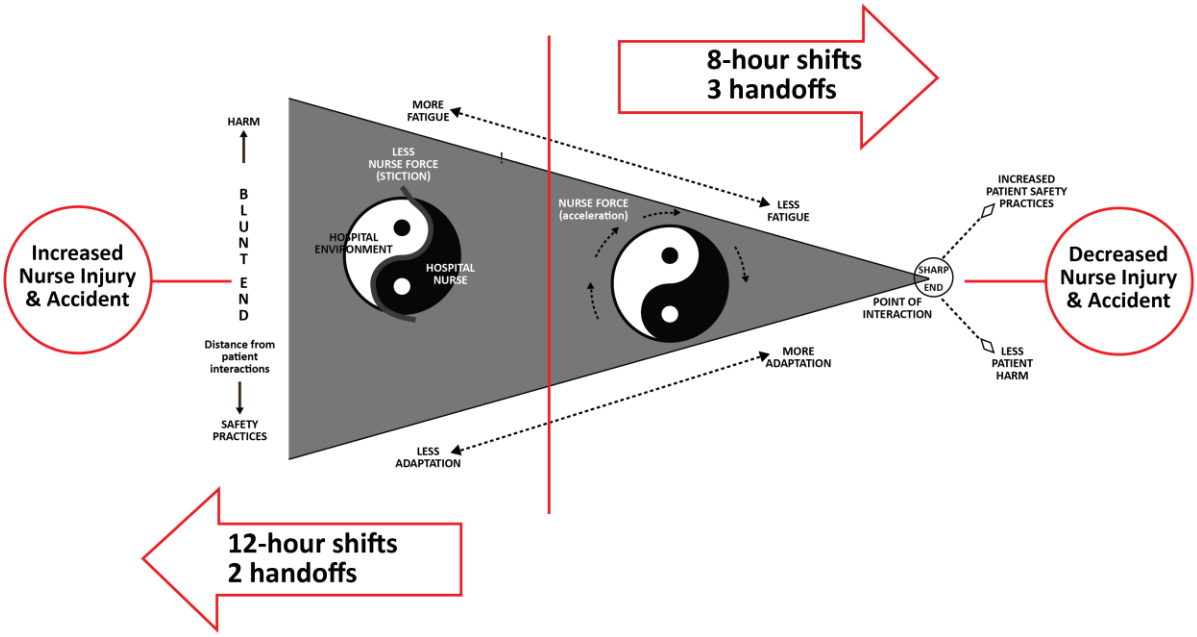


*Figure 2. Hospital Nurse Force Theory with Study Variables*
Adapted with permission from Drake, 2012, by researcher.

## Conceptual and Operational Definitions

The conceptual and operational definitions of the study variables can be found in Table 2

*Table 2. Conceptual and Operational Definitions of Variables*

| Theoretical Concept | Study Variable | Conceptual Definition | Operational Definition |
|---|---|---|---|
| Nurse Fatigue | Work-related fatigue | Inadequate adaptation and restoration of work energy | Occupational Fatigue Exhaustion Recovery Scale (OFER), 3 subscales<br>• Chronic Fatigue<br>5 items, 0 – 7 scale<br>Sum score range 0 – 30<br>Scores summed to continuous level data.<br>Total score ranges from 0 – 100 using the formula, sum (item scores)/30 x 100<br>Reliability is α >.84<br>• Acute Fatigue<br>5 items, 0 – 7 scale<br>Sum score range 0 - 30<br>Scores summed to continuous level data.<br>Total score ranges from 0 – 100 using the formula, sum (item scores)/30 x 100<br>Reliability is α >.86<br>• Persistent Fatigue<br>5 items, 0 – 7 scale<br>Sum score range 0 - 30<br>Scores summed to continuous level data.<br>Total score ranges from 0 – 100 using the formula, sum (item scores)/30 x 100<br>Reliability is α >.84<br>• Total Fatigue<br>15 items, 0 – 7 scale<br>Sum score range 0 – 90<br>Scores summed to continuous level data.<br>Total score ranges 0 – 100 using the formula sum (all items)/90 x 100<br>Reliability to be established and reported with study results. |

*Table 2. Conceptual and Operational Definitions of Variables (Continued)*

| | | | |
|---|---|---|---|
| Hospital Environment | Shift length | Amount of time spent working | Two researcher developed items:<br>1. Do you most often work 8-hour or 12-hour shifts?<br>2. What is the average actual length of shift (in hours) you worked in the last 10 days? |
| | Handoffs | Transfer of information during transitions in care | Hanover Evaluation Scale (HES), 14 items, 7-point scale<br>Scores summed to continuous level data. Sum score range 0 – 84. |
| Harm (Patient/Nurse) | Error (patient) | Any preventable event, mistake, or inadvertent occurrence that harms or has the potential to harm the patient. | Six researcher developed items:<br>1. How many errors (any preventable event, mistake, or inadvertent occurrence that harms or has the potential to harm the patient) have you made in the last twelve months?<br>2. How many of the errors cited above were medication errors?<br>3. How many near errors (an error that happened but did not reach the patient) have you made in the last twelve months?<br>4. On a visual analog scale of 0% to 100%, rate the following statements:<br>• I believe ____% of errors I have made are related to fatigue.<br>• I believe ____% of errors I have made are related to handoff. |
| | Accident/Injury (nurse) | Any preventable event, mistake, or inadvertent occurrence that harms or has the potential to harm a nurse (needle stick, slip, trip, splash, fall, auto accidents) | 5. How many work-related injuries/accidents have you experienced in the last twelve months?<br>6. On a visual analog scale of 0% to 100%, rate the following statement:<br>• I believe ____% of personal injuries/ accidents I have experienced are related to fatigue. |

## Research Hypotheses

The purpose of this study was to determine the differences between 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) work-related fatigue and MN nurses' personal safety among MN nurses who work 8- and 12-hour shifts. Research hypotheses included:

Ha1: MN nurses working 12-hour shifts will experience a greater level of fatigue than MN nurses working 8-hour shifts.

Ha2: There is no difference in handoff quality among MN nurses who work 8-hour versus 12-hour shifts.

Ha3: MN nurses working 12-hour shifts will report more patient errors than MN nurses working 8-hour shifts.

Ha4: MN nurses working 12-hour shifts will report more personal injuries/accidents than MN nurses working 8-hour shifts.

Ha5: Ineffective handoffs and fatigue have a direct and interaction effect on the number of errors and near errors (patient harm) made by MN nurses.

Ha6: Ineffective handoffs and fatigue have a direct and interaction effect on MN nurses' personal safety (nurse harm).

## Research Design

A randomly selected sample of MN nurses were recruited to participate in this cross-sectional study to determine the differences between 8-hour and 12-hour shifts related to 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) work-related fatigue and MN nurses' personal safety.

## Methods

The study sample was a national random selection of MN nurses who worked 8-hour or 12-hour shifts. To obtain the national random sample, the inclusion criteria were sent to the membership coordinator of the Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN). The membership coordinator entered the inclusion criteria and the desired sample size (purchased in blocks of 1,000) into the AWHONN membership database. Then, the database randomly selected members who fit the inclusion criteria to receive the study invitation. Inclusion criteria for the study included: MN nurses who provided direct patient care, were members of the AWHONN, were employed full-time, worked 8-hour or 12-hour shifts, had a minimum of one year of experience, were able to read and speak English, and did not have a current or past history of sleeping disorders.

Using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) a minimum sample size of 102 (51 MN nurses who work 8-hour shifts and 51 MN nurses who work 12-hour shifts) was needed for a medium effect size of 0.5, alpha of 0.05, and power of 0.80. A letter of invitation (Appendix A) was sent to a total of 2,389 AWHONN members, 12% of the total AWHONN membership. A study by Wright and Schwager (2008) showed 16.5% of individuals invited to participate in a research study actually do, so oversampling was done intentionally. The study was approved by the Institutional Review Board (IRB) at the University of Texas at Tyler (Appendix B) and the AWHONN Board of Directors (Appendix C) before data collection began.

After reading the study invitation, the randomly selected AWHONN members who decided to participate in the study, accessed the study survey by opening the link at

the bottom of the study invitation. Consent was part of the online survey (Appendix D). Consent was implied if AWHONN members proceeded to the survey after reading the consent form. The informed consent made participants aware that 1) they were voluntarily participating in a research study to examine the effect of shift length, fatigue and nursing handoffs on patient and nurses' personal safety; 2) they would not be harmed in any way; 3) every effort would be made to maintain their confidentiality and anonymity; 4) they had the right to withdraw from the study at any time for any reason; 5) an online survey software program would be used to collect data; 6) the information they provided would be used to examine the effect shift length, fatigue, and nursing handoffs have on patient and nurses' personal safety; 7) there was the risk of feeling some distress while recalling experiences; and 8) the benefit of advancing nursing science through participation in this study.

**Instruments**

Data were obtained via an electronic survey that contained a demographic data sheet, a researcher developed notable event recall report (referred to as notable event recall report in the remainder of the paper), the Occupational Fatigue Exhaustion Recovery scale (OFER) (Winwood, Winefield, Dawson, & Lushington, 2005), and the Handover Evaluation Scale (HES) (O'Connell, Ockerby, & Hawkins, 2014). The survey was administered via Qualtrics, a web-based survey software platform.

***Demographic Data Sheet (Appendix E).*** Demographic information was collected to describe the sample and their working conditions. The demographic variables included gender; age; years employed as a nurse; length of shift hired to work; shift typically worked (days, evenings, nights, rotating); number of shifts worked in past 14 days;

number of shifts worked in past 14 days that included extra hours or overtime; average number of extra hours or overtime; work department; number of beds in their department; whether their facility had been awarded Magnet status; number of patients they typically cared for while working; do they most often work 8-hour or 12- hour shifts, if they worked 12-hour shifts and 8-hours shifts were available, would they prefer to work 8-hour shifts; did they work more than one job and if yes, the number of hours worked per week at the other job; did they get an opportunity to take breaks and/or eat meals free of patient care, and if they did get the opportunity, how often it occurred. Asking participants to report the number of hours worked in the past 14 days, and the amount of extra hours and/or overtime worked during those 14 days was chosen because many hospitals use computerized time cards. Those hospitals require their nurses to verify their time cards at the end of the two week pay period. Thus, nurses should be able to recall the number of shifts worked, and the number of extra hours and/or overtime worked during that time period.

***Notable Event Recall Report (Appendix F).*** The researcher developed notable event recall report captured errors that harmed or had the potential to harm a patient or a nurse. The notable event recall report contained four questions. Three of the four questions asked for the number of errors or near errors the participant made within the last twelve months. The fourth question asked for the number of work-related injuries/accidents the participant experienced in the last twelve months. The time frame for recalling errors or near errors was based on a study that reported significant results ($r_s$ = .60, $p$ = 0.001) between fatigue and medication errors made in the past 12 months (Morelock, 2014).

In addition to the four questions, the notable event recall report also asked participants to respond to three statements using visual analog scales. Two related to the percentage of errors made due to fatigue or handoff. The third concerned the percentage of work-related injuries/accidents experienced due to fatigue. The use of visual analog scales allowed participants to determine their own response to each statement rather than requiring them to choose from answer options predetermined by the principal investigator (PI). A study conducted by Hasson & Arnetz (2005) compared visual analog scales to Likert scales. Their results indicated "the single VAS and single Likert items measuring the same construct were highly correlated" (p. 5) with intraclass correlations ranging from .90-.91, $p<.05$. Knowing this, either visual analog scales or Likert scales could have been used to collect data about each statement. However, this PI opted to allow study participants to provide their own responses.

A pilot study was conducted on the notable event recall report. The sample consisted of ten MN nurses who were certified in either neonatal intensive care, inpatient obstetrics, low risk neonate, or mother newborn nursing, and six noncertified MN nurses (total N=16). Feedback was received from fourteen of the MN nurses. Seven suggested adding anchors to the visual analog scales to further clarify the meaning of 0 and 10. Following that suggestion, anchors were added to the visual analog scales. Apart from this one suggestion, all fourteen indicated the questions and statements were clear, concise and easily understood. This signified that the questions and statements captured the intent of the measures supporting face validity.

***Occupational Fatigue Exhaustion Recovery Scale (OFER) (Appendix G).*** The Occupational Fatigue Exhaustion Recovery scale (OFER) (Winwood et al., 2005) was

used to measure work-related fatigue. The 15-item scale contains three subscales, including chronic fatigue, acute fatigue, and persistent fatigue, which were totaled for an overall fatigue score. Each subscale contains five items rated on a 7-point Likert scale from 0 (strongly disagree) to 6 (strongly agree). Each OFER subscale demonstrated high internal reliability, with the chronic subscale $\alpha$ =.86; acute fatigue subscale $\alpha$ =.84; and persistent fatigue subscale $\alpha$ =.84 (Winwood, Lushington, & Winefield, 2006).

No studies were found where the OFER scale was used to derive a total fatigue score. This was confirmed by the OFER scale author (P. Winwood, personal communication, November 11, 2015). After discussing the possibility of using the OFER scale for this purpose, Winwood reiterated that the OFER scale is capable of measuring intershift recovery or persistent fatigue in addition to acute and chronic fatigue. The intershift recovery subscale measures recovery from fatigue which should occur between work shifts. If recovery from fatigue does not occur, it can lead to persistent fatigue. Persistent fatigue can be measured with the persistent fatigue subscale which is derived by reverse coding specific items on the intershift recovery subscale. According to the Manual for the Occupational Fatigue, Exhaustion Recovery Scale (Winwood, 2005), an "additional feature of the OFER scale relates to scoring and interpretation of scores on the Recovery subscale" (p. 4). "The Recovery subscale comprises three negatively keyed and two positive keyed items. In order to calculate effective Recovery, items 11, 13 and 15 are therefore recoded before summing. However, if instead the items recoded are 12 and 14, then, rather than a measure of Recovery, this subscale can be regarded as a measure of Persistent Fatigue (between shifts). The use of this subscale can be of value in those studies particularly concerned with potential maladaptive work environments and

its effects" (Winwood, 2005, p. 4-5). A total fatigue score could be derived by summing the scores of the acute, chronic and persistent fatigue subscales. Since the study focused on work-related fatigue, this scale was appropriate for measuring that variable. Cronbach's α for this study were .90 for both chronic and acute fatigue, .89 for persistent fatigue, and .94 for total overall fatigue.

***Handover Evaluation Scale (HES) (Appendix J).*** The Handover Evaluation Scale a "simple, valid, and reliable measure that can be used in practice to monitor the quality of handover" (O'Connell et al., 2014, p. 569) was used to measure the quality of handoffs. It is a 14-item scale containing three subscales including quality of information (six items), interaction and support (five items), and efficiency (three items). Items in each subscale are rated using a 7-point Likert scale from strongly disagree (0) to strongly agree (6). An overall high score on the HES indicated a high quality handoff whereas a low score indicated a low quality handoff (O'Connell et al., 2008). Reliability analyses conducted on each subscale revealed a Cronbach's alpha of 0.80 for quality of information, 0.86 for interaction and support, and 0.69 for efficiency (O'Connell et al., 2014). During handoff, there is the possibility that pertinent patient information is unintentionally not reported. This could be due to a variety of reasons. The additional patient handoff required when working 8-hour shifts may lead to an increase in errors, which could compromise patients' safety. Utilizing the HES, nurses will be able to provide their perceptions about the quality of handoff that occurs in their facility. Information obtained using this scale may provide evidence that handoffs are problematic and can lead to errors that jeopardize patient safety. Cronbach's α for this study were .79

for quality of information, .77 for interaction and support, .56 for efficiency, and .85 for overall handoff quality.

**Data Collection**

Data collection began following IRB approval from the University of Texas at Tyler and approval from the AWHONN Board of Directors. The survey invitation, which contained the Qualtrics survey link and the informed consent form, was then sent to a randomly selected group of 1,196 AWHONN members by the AWHONN membership coordinator. Two weeks after the initial survey invitation had been distributed, a follow-up email was sent by the AWHONN membership coordinator to encourage and remind the random sample of AWHONN members to participate in the study by completing the survey. At the end of three weeks, a third email reminder was sent by the AWHONN membership coordinator. By the end of the fourth week, there was a minimum of 51 responses in the 8-hour group and 118 responses in the 12-hour group. Unfortunately, sixteen surveys from MN nurses who worked 8-hour shifts were incomplete, reducing the sample size for the 8-hour group to 35. Due to the decrease in the sample size of the 8-hour group, the survey invitation containing the Qualtrics survey link and the informed consent form was sent to a second randomly selected group of 1,193 AWHONN members. Eight days after the survey invitation was sent to the second group of randomly selected AWHONN members, the minimum sample size of 51 was exceeded and the survey was closed. Results were downloaded, stored, and analyzed on a password protected computer.

**Analysis**

All analyses were performed using IBM Statistical Package for the Social

Sciences (SPSS), version 20. Prior to conducting the analyses, relevant variables were recoded as directed by the instrument instructions. All variables were tested to ensure that assumptions required for statistical testing were met. Frequency distributions, histograms, skewness and kurtosis were reviewed. Persistent fatigue, total fatigue and handoff quality were normally distributed. Acute fatigue and chronic fatigue did not meet the assumption of normality because the 12-hour group had a significant Kolmogorov-Smirnov (KS) test. However, according to Fields (2009) obtaining significant KS results is not uncommon when the study sample size is large and the deviations from normality are small. Fifteen outliers were identified between acute and chronic fatigue. The outliers were winsorized and replaced with the next highest or lowest value. Mean substitution was used to manage missing data. The assumption for homogeneity of variance (HOV) was met for all variables.

The independent sample *t*-test was used to determine differences between the two groups in hypotheses one through four. Field (2009) recommends use of Welch's *t*-test, more commonly known as the unequal variances *t*-test, when there is a large difference in group sample size. Twice as many nurses worked 12-hour shifts as worked 8-hour shifts. This substantial difference in group size resulted in the decision to use the Welch's t-test to interpret results even when the homogeneity of variance was not violated. In addition, due to the failed assumption of normality for acute and chronic fatigue, significant statistical results were verified with the more robust bootstrap and the more conservative non-parametric Mann-Whitney test. A significant bootstrap procedure supports generalizability of results beyond the study sample.

Hierarchical multiple regression was conducted to examine the relationship

between the dependent and predictor variables in hypotheses five and six. The dependent variables for this study were patient errors, and nurse accident and injury. The predictor variables for this study were handoff quality, and work-related fatigue. Hierarchical multiple regression was selected based on previous research that showed fatigue and poor handoff quality could lead to patient errors and nurse work-related injuries/accidents. Studies that revealed fatigue is associated with patient errors included Olds and Clarke (2010); Edwards et al. (2013); Scott, Rogers, Hwang, and Zhang (2006); Rogers et al. (2004); Trinkoff et al. (2011). Studies that showed poor handoff quality could be associated with patient errors included Ebright, Urden, Patterson, and Chalko (2004); Friesen, White, and Byers (2008); Riesenberg, Leitzsch, and Cunningham, (2010). Studies that revealed fatigue could be associated with nurse work-related injuries/accidents included Edwards et al. (2013); Olds and Clarke (2010); Johnson, Brown, and Weaver (2010); Scott, Hoffmeister, and Rogness, and Rogers (2010); Scott et al. (2007); Trinkoff et al. (2008).

All predictor variables were mean centered to reduce multicollinearity, which could result in model coefficients appearing to be statistically non-significant when they were in fact statistically significant (Schielzeth, 2010). The predictor variables were centered using a two-step process in SPSS. First, an arithmetic mean was calculated for each predictor variable. Second, the arithmetic mean was subtracted from the original values of its respective predictor. The interaction variable was created by multiplying the centered predictor variables together. The predictor variables included centered total fatigue and centered handoff quality and a centered interaction variable that consisted of centered total fatigue and centered handoff quality combined. Centered total fatigue and

centered handoff quality were entered in step one of the regression. The centered interaction variable was entered in step two of the regression.

Confidence intervals are noted in statistical results as 95% CI, which means there is a 95% chance that the true population mean will fall between the lower limit and upper limit of the confidence interval range and if the study was repeated 100 times, the same values would be obtained 95% of the time (Hirpara, Jain, Gupta, & Dubey, 2015).

## Results

***Sample.*** A total of 24,000 MN nurses are members of AWHONN. The survey invitation was sent to 2,389 of those members. A total of 305 MN nurses opened the survey. However, 83 surveys were incomplete and removed from the data set. One survey was removed because the participant had less than one year of nursing experience, which did not meet the inclusion criteria. In total, 84 surveys were removed, resulting in an attrition rate of 28%. The final sample was 221 MN nurses. The overall response rate was 9.3% representing 0.9% of the total AWHONN membership.

Of the 221 MN nurses, 70 were in the 8-hour shift group and 151 were in the 12-hour shift group. The MN nurses in the 8-hour shift group were female (n = 69), with a mean age (in years) of 47.12 (± 10.85) ranging in age from 23 to 68 years old. On average, they had 21.69 (± 11.94) years of nursing experience. The 12-hour shift MN nurses were also predominantly female (n = 148) with two males in this group. Their mean age (in years) was 46.88 (± 11.20) ranging in age from 23 to 67 years old. On average, they had 19.55 (± 10.94) years of nursing experience. The majority of nurses in both groups worked in Labor and Delivery (61.5%) with 62.9% of the MN nurses in the 8-hour group working day shift (7a – 3p) and 55.6% of MN nurses in the 12-hour group

working day shift (7a – 7p). While most MN nurses in the 12-hour group did not desire to work 8-hour shifts, 38.7% of the MN nurses in the 12-hour group would prefer to work 8-hour shifts. Some nurses in each group worked more than one job. A small portion of nurses in each group worked in facilities that had obtained magnet status. A larger portion of nurses in each group were able to take breaks or eat meals at least once a shift, but they did so while remaining responsible for their patients (see Table 3 & 4).

Statistical analyses of the two groups' demographics using the Mann Whitney test for continuous variables and the chi-squared test for categorical data did not reveal statistically significant differences in age, years of experience, magnet facility, and number of beds per unit or more than one job. A statistically significant difference between the two groups was revealed for the number of shifts worked in the past two weeks (U = 1703.5, $z$ = -8.379, $p$ = .000, $r$ = .6) and the number of extra hours and overtime worked per shift (U = 4015, $z$ = -2.314, $p$ = .01, $r$ =.*2*). However, one would expect there to be a difference in number of shifts worked in a two-week period since nurses who work 12-hour shifts typically work six shifts while nurses who work 8-hour shifts typically work ten shifts (see Table 3). The total hours worked in the past 14 days was calculated using the independent sample *t*-test to determine if there was a difference in the total number of hours worked in the past 14 days between the two groups. The maternal newborn nurses in the 12-hour shift group worked an average of 1.7 hours more than maternal newborn nurses in the 8- hour group. The difference between the two groups was not statistically significant $t(149.17) = -.519$, $p$ =.60, $r$ =.04, 95% CI [-8.19, 4.78].

*Table 3. Demographic Data Categorical Variables*

| Demographic | 8-hour | | 12-hour | |
|---|---|---|---|---|
| | N | % | N | % |
| Gender (female/male) | 69/0 | 98.6 | 148/2 | 98.1 |
| Magnet Facility | | | | |
| Yes | 16 | 22.9 | 53 | 35.1 |
| No | 54 | 77.1 | 98 | 64.9 |
| Unit of Work | | | | |
| High Risk Obstetrics | 6 | 8.6 | 18 | 11.9 |
| Labor & Delivery | 49 | 70.0 | 87 | 57.6 |
| Mother Baby | 10 | 14.3 | 32 | 21.2 |
| Neonatal Intensive Care | 2 | 2.9 | 6 | 4.0 |
| Newborn Nursery | 2 | 2.9 | 2 | 1.3 |
| Postpartum | 1 | 1.4 | 6 | 4.0 |
| Time of Work | | | | |
| Days (7a – 3p) | 44 | 62.9 | | |
| Evenings (3p – 11p) | 7 | 10.0 | | |
| Nights (11p – 7a) | 15 | 21.4 | | |
| Rotating | 4 | 5.7 | | |
| Days (7a – 7p) | | | 84 | 55.6 |
| Night (7p – 7a) | | | 52 | 34.4 |
| Rotating | | | 10 | 6.6 |
| Work 12-hours but want 8-hours | | | 58 | 38.7 |
| Yes | | | 92 | 61.3 |
| No | | | | |
| Work >1 job | | | | |
| Yes | 15 | 21.4 | 29 | 19.2 |
| No | 55 | 78.6 | 122 | 80.8 |
| Break/Meal Opportunities | | | | |
| None | 5 | 7.1 | 11 | 7.3 |
| With Pt Care | 47 | 67.1 | 92 | 60.9 |
| Without Pt Care | 18 | 25.7 | 48 | 31.8 |
| Break/Meal Frequency | | | | |
| Once a shift | 44 | 64.7 | 94 | 63.1 |
| Once a week | 10 | 14.7 | 22 | 14.8 |
| Once a month | 1 | 1.5 | 6 | 4.0 |
| Other | 13 | 19.1 | 27 | 18.1 |

*Table 4. Demographic Data Continuous Variables*

| Demographic | 8-hour | | | 12-hour | | |
|---|---|---|---|---|---|---|
| | *M (SD)* | Range | N | *M (SD)* | Range | N |
| Age (years) | 47.12 (10.85) | 23 - 68 | 70 | 46.88 (11.20) | 23 - 67 | 151 |
| Years as RN | 21.69 (11.94) | 2 - 44 | 69 | 19.55 (12.16) | 2 - 48 | 151 |
| Size of Unit (# of beds) | 20.66 (12.44) | 2 - 60 | 70 | 22.34 (12.57) | 4 - 61 | 151 |
| Shifts Worked in 14 Days | 8.51 (1.93) | 2 - 13 | 70 | 6.08 (1.63) | 1 - 13 | 151 |
| Extra Hours/OT per Shift | 2.18 (2.26) | 0 -12 | 68 | 1.51 (2.09) | 0 - 42 | 146 |
| Hours/Wk Other Job | 13.67 (10.19) | 4 - 40 | 15 | 17.10 (10.94) | 4 - 40 | 29 |
| Total Hours Worked in Past 14 Days | 79.68 (21.84) | 24 - 138 | 70 | 81.38 (24.31) | 16 - 168 | 149 |

The number and type of patients maternal newborn nurses cared for over the course of their shift varied based on the work department. Over the course of 8-hours, MN nurses reported caring for up to 4 high risk patients, 3-6 couplets, 1-6 laboring patients, 1-3 high risk newborns in the neonatal intensive care unit, up to six newborns in the newborn nursery and four postpartum patients. Over the course of 12-hours, MN nurses reported caring for up to four high risk patients, 2-7 couplets, 1-8 laboring patients, 2-4 high risk newborns in the neonatal intensive care unit, up to eight newborns in the newborn nursery and up to nine postpartum patients (see Table 5).

*Table 5. Average Patient Assignment*

| Work Department<br>Patient Type | 8-hour<br># of Patients | 12-hour<br># of Patients |
|---|---|---|
| High Risk Obstetrics | | |
| High Risk Patients | 1-4 | 1-6 |
| Couplets | 3 | 3-4 |
| Labor & Delivery | | |
| Labor Patients | **1-6** | **1-8** |
| High Risk Patients | **0** | **1-2** |
| Postpartum Patients | **0** | **2** |
| PACU Patients | **0** | **5** |
| Mother/Baby | | |
| Couplets | 3-6 | 2-7 |
| Neonatal Intensive Care | | |
| High Risk Newborns | 1-3 | 2-4 |
| Newborn Nursery | | |
| Newborns | 3-6 | 4-8 |
| Postpartum | | |
| Postpartum Patients | 4 | 3-9 |

***Hypothesis Tests.*** The instruments used for hypotheses testing, their associated variables and the mean, standard deviation and range for each variable are shown in Table 6.

*Table 6. Instruments and Associated Variables*

| Instrument | 8-hour shift<br>Mean (SD) | 12-hour shift<br>Mean (SD) | Ranges |
|---|---|---|---|
| Notable Events | | | |
| Patient Errors* | 1.56 (2.97) | 1.76 (3.14) | 8-hour shift: 0 - 20<br>12-hour shift: 0 – 24 |
| Medication Errors | .37 (.93) | .40 (.84) | 8-hour shift: 0 – 6<br>12-hour shift: 0 – 6 |
| Near Errors | 1.93 (3.33) | 1.94 (3.62) | 8-hour shift: 0 - 19<br>12-hour shift: 0 – 23 |
| Work related injuries/accidents | .29 (.82) | .50 (1.20) | 8-hour shift: 0 - 5<br>12-hour shift 0 – 6 |
| | | | |
| OFER | | | |
| Acute Fatigue* | 68.18 (22.02) | 74.84 (21.72) | 8-hour shift: 24 – 76<br>12-hour shift: 20 – 100 |
| Chronic Fatigue | 53.33 (26.38) | 56.78 (27.73) | 8-hour shift: 0 – 100<br>12-hour shift: 0 – 100 |
| Persistent Fatigue | 50.16 (24.48) | 56.07 (24.10) | 8-hour shift: 3.33 – 100<br>12-hour shift: 0 – 100 |

*Table 6. Instruments and Associated Variables (Continued)*

| Instrument | 8-hour shift Mean (SD) | 12-hour shift Mean (SD) | Ranges |
|---|---|---|---|
| OFER | | | |
| Total Fatigue* | 57.05 (22.86) | 62.84 (20.77) | 8-hour shift: 4.44 – 98.89<br>12-hour shift: 15.56 – 100 |
| HES | | | |
| Quality of Information | 5.07 (.81) | 5.22 (.81) | 8-hour shift: 3.33 - 7<br>12-hour shift: 3.17 – 6.83 |
| Interaction & Support | 4.92 (1.01) | 5.01 (1.05) | 8-hour shift: 2.8 – 7<br>12-hour shift: 2 - 7 |
| Efficiency | 4.16 (1.03) | 4.20 (1.17) | 8-hour shift: 2.33 – 6.33<br>12-hour shift: 1.33 - 7 |
| Overall Perception of Handoff | 4.83 (.67) | 4.90 (.77) | 8-hour shift: 3.57 – 6.07<br>12-hour shift: 3.07 – 6.64 |

**Note:** *groups differ at $p < .05$

***Hypothesis One.*** In Table 6, the means for all four types of fatigue were higher for the MN nurses in the 12-hour shift group. This indicates, on average, nurses who worked 12-hour shifts reported experiencing greater levels of chronic, acute, persistent, and total fatigue than nurses who worked 8-hour shifts. The differences in chronic and persistent fatigue were not statistically significant between the two groups. However, the differences in acute and total fatigue were statistically significant. Nurses who worked 12-hour shifts reported greater acute fatigue and greater total fatigue than nurses who worked 8-hour shifts. This was confirmed with bootstrap. The difference in acute fatigue, -6.70, BCa 95% CI [-12.73, -.68] was statistically significant $t(132.63) = -2.139$, $p = .02$, $r = .2$. The difference in total fatigue -5.53, BCa 95% CI [-12.17, .64] was statistically significant $t(124.32) = -1.739$, $p = .04$, $r = .2$. The confidence interval for total fatigue crosses zero so caution is required when applying the results to the general population. These statistically significant results were also confirmed with a Mann-Whitney test. Median acute fatigue scores for 8-hour shift nurses (71.67) and 12-hour shift nurses (80.0) were statistically significantly different, $U = 4237$, $z = -2.374$, $p = .02$, $r = -.2$.

Median total fatigue scores for 8-hour shifts nurses (61.11) and 12-hour shift nurses (65.56) were statistically significantly different, $U = 4522.5$, z = -1.725, $p = .04$, $r = -.1$ (see Table 7). The nonparametric Mann-Whitney test provides support for the significance of the differences within the sample despite the non-normal distribution of the acute fatigue scores.

*Table 7. Fatigue Differences of Nurses Who Work 8- and 12-hour Shifts*

| | 8-Hour Shift | | 12-Hour Shift | | | | |
|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *t* | *p* | 95% CI |
| Chronic | 53.48 | 26.35 | 56.35 | 28.13 | -.739 | .23 | [-10.57, 4.82] |
| Acute | 68.13 | 21.77 | 74.83 | 21.43 | -2.14 | .02 | [-12.73, -.68]* |
| Persistent | 50.10 | 24.33 | 55.84 | 23.81 | -1.64 | .05 | [-12.64, 1.18] |
| Total | 57.07 | 22.60 | 62.61 | 20.68 | -1.74 | .04 | [-12.17, .64]* |

**Note:** * = Bootstrap Confidence Interval; CI = Confidence Interval

***Hypothesis Two.*** Nurses working 12-hour shifts reported slightly higher handoff quality (M = 5.22, SD = .81) than nurses working 8-hour shifts (M = 5.07, SD = .81), and the findings were not statistically significant $t(133.69) = -1.039$, $p = .30$, $r = .1$, 95% CI [-.35, .11].

***Hypothesis Three.*** On average, nurses working 12-hours shifts reported more patient errors (M = 1.76, SD = 3.14), more medication errors (M = .40, SD = .84), and more patient near errors (M = 1.94, SD = 3.62) than nurses working 8-hour shifts (M = 1.56, SD = 2.97 for patient errors, M = .37, SD = .93 for medication errors, and M = 1.93, SD = 3.33 for patient near errors). However, the differences between the two groups were not statistically significant $t(136.71) = -.462$, $p = .32$, $r = .04$, 95% CI [-1.08, .67] for

patient errors; $t(113.02) = -.249$, $p = .40$, $r = .02$, 95% CI [ -.30, .23] for medication errors; $t(144.23) = -.022$, $p = .49$, $r = .002$, 95% CI [ -.10, .98] for patient near errors.

***Hypothesis Four.*** On average, nurses working 12-hour shifts reported more work-related injuries/accidents (M = .50, SD = 1.20) than nurses working 8-hour shifts (M = .29, SD = .82). The difference was not statistically significant $t(185.11) = -1.528$, $p = .06$, $r = .1$, 95% CI [-.49, .06].

***Hypothesis Five.*** Hierarchical multiple regression was conducted to determine the ability to predict patient errors from ineffective handoffs and fatigue. Assumption testing revealed linearity as assessed by partial regression plots. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.882. Homoscedasticity, assessed by visual inspection of a plot of standardized residuals versus unstandardized predicted values was not funnel shaped and indicated that the data met the assumption. However, the plot did not reflect constraint, indicating a potential violation of unbounded variability. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than $\pm$ 3 standard deviations, no leverage values greater than 0.2, or values for Cook's distance above 1.

Due to potentially constrained variability, bootstrap was performed to allow study results to be generalized beyond the study sample. In step one, total fatigue and handoff quality contributed significantly to the regression model, $F(2, 183) = 9.379$, $p = .000$, and accounted for 9.3% of the variation in patient errors. Introducing the interaction variable explained an additional 1.4% of the variation in patient errors however, this change in $R^2$ was not statistically significant, $F(1, 182) = 2.954$, $p = .09$. Step one was the best step for predicting patient errors and indicates that the interaction between total fatigue and

handoff quality did not add significantly to the model. Centered total fatigue was highly significant ($p$ = .000) for predicting patient errors (see Table 8).

*Table 8. Hierarchical Multiple Regression of Predictors of Errors: Handoffs and Fatigue* (N = 186)

| Variable | B | $SE_B$ | β | *t* | *p* |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| Constant | 1.033 [.835, 1.244] | .100 | | 10.281 | .000 |
| Centered Total Fatigue | .018 [.009, .027] | .005 | .271 | 3.635 | .000 |
| Centered Handoff Quality | -.135 [-.385, .129] | .131 | -.077 | -1.034 | .302 |
| Step 2 | | | | | |
| Constant | .979 [.785, 1.174] | .105 | | 9.341 | .000 |
| Centered Total Fatigue | .021 [.010, .031] | .005 | .319 | 4.026 | .000 |
| Centered Handoff Quality | -.125 [-.393, .123] | .130 | -.071 | -.959 | .34 |
| Centered Total Fatigue & Centered Handoff Quality | -.009 [-.021, .002] | .005 | -.129 | -1.719 | .09 |

**Note.** *B* = unstandardized regression coefficient; $SE_B$ = Standard error of the coefficient; β = standardized coefficient; Bootstrap 95% Confidence Intervals reported in []; $R^2$ = .093 for Step 1; $\Delta R^2$ = .014 for Step 2.

Another hierarchical multiple regression was conducted to determine the ability to predict patient near errors from ineffective handoffs and fatigue. The criterion variable was patient near errors. The predictor variables were centered total fatigue, centered handoff quality, and a centered interaction variable that consisted of centered total fatigue and centered handoff quality combined. Centered total fatigue and centered handoff quality were entered in step one of the regression. The centered interaction variable was entered in step two.

Assumption testing revealed linearity as assessed by partial regression plots.

There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.945. Homoscedasticity, assessed by visual inspection of a plot of standardized residuals versus unstandardized predicted values, was not funnel shaped and indicated that the data met the assumption. However, the plot did reflect constraint, indicating a potential violation of unbounded variability. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ± 3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1.

Due to potentially constrained variability, a bootstrap was performed to allow study results to the generalized beyond the study sample. In step one, centered total fatigue and centered handoff quality contributed significantly to the regression model, $F(2, 182) = 4.112$, $p = .02$, and accounted for 4.3% of the variation in patient near errors. Introducing the centered interaction variable explained an additional .3% of the variation in patient near errors. However, this change in $R^2$ was not statistically significant, $F(1, 181) = .482$, $p = .49$. Even though centered total fatigue and centered handoff quality were not statistically significant in step one, step one was the best step for predicting patient near errors (see Table 9).

*Table 9. Hierarchical Multiple Regression of Predictors of Near Errors: Handoffs and Fatigue*
(N = 185)

| Variable | B | $SE_B$ | β | *t* | *p* |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| Constant | .916 [.759, 1.074] | .080 | | 11.453 | .000 |
| Centered Total Fatigue | .006 [-.002, .013] | .004 | .109 | 1.421 | .16 |

*Table 9. Hierarchical Multiple Regression of Predictors of Near Errors: Handoffs and Fatigue (Continued)*

| Variable | B | $SE_B$ | β | *t* | *p* |
|---|---|---|---|---|---|
| Centered Handoff Quality | -.196 [-.401, .010] | .104 | -.145 | -1.881 | .06 |
| | | Step 2 | | | |
| Constant | .934 [.768, 1.100] | .084 | | 11.110 | .000 |
| Centered Total Fatigue | .005 [-.004, .013] | .004 | .089 | 1.083 | .28 |
| Centered Handoff Quality | -.199 [-.405, .007] | .104 | -.147 | -1.909 | .06 |
| Centered Total Fatigue & Centered Handoff Quality | .003 [-.006, .012] | .004 | .054 | .695 | .49 |

**Note.** *B* = unstandardized regression coefficient; $SE_B$ = Standard error of the coefficient; β = standardized coefficient; Bootstrap 95% Confidence Intervals reported in []; $R^2$ = .043 for Step 1; $\Delta R^2$ = .003 for Step 2.

***Hypothesis Six.*** Hierarchical multiple regression was run to determine the ability to predict nurse work-related injuries and accidents from ineffective handoffs and fatigue. The criterion variable was nurse accident and injury. The predictor variables were centered total fatigue, centered handoff quality, and a centered interaction variable that consisted of centered total fatigue, centered handoff quality combined. Centered total fatigue and centered handoff quality were entered in step one of the regression. The centered interaction variable was entered in step two. Homoscedasticity, assessed by visual inspection of a plot of standardized residuals versus unstandardized predicted values was not funnel shaped and indicated that the data met the assumption. However, the plot did reflect constraint, indicating a potential violation of unbounded variability. In addition, linearity is questionable. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.852. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals, no

leverage values greater than 0.2, and values for Cook's distance above 1.

Due to potentially constrained variability and lack of linearity, bootstrapping was performed. In step one, centered total fatigue and centered handoff quality did not contribute significantly to the regression model, $F(1, 175) = 2.688$, $p = .07$, and accounted for 3% of the variation in nurse work-related injuries and accidents. Introducing the centered interaction variable explained an additional .5% of the variation in nurse work-related accidents and injuries. This change in $R^2$ was not statistically significant, $F(1, 174) = 1.903$, $p = .17$. These hierarchical multiple regression models were not statistically significant for predicting nurse work-related injuries and accidents (see Table 10).

*Table 10. Hierarchical Multiple Regression of Predictors of Nurse Accidents and Injuries: Handoffs and Fatigue*
(N = 178)

| Variable | B | $SE_B$ | β | *t* | *p* |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| Constant | .122 [.079, .175] | .025 | | 4.937 | .000 |
| Centered Total Fatigue | .002 [.001, .004] | .001 | .157 | 2.010 | .05 |
| Centered Handoff Quality | .056 [-.007, .122] | .032 | .134 | 1.713 | .09 |
| Step 2 | | | | | |
| Constant | .131 [.085, .186] | .026 | | 5.139 | .000 |
| Centered Total Fatigue | .002 [2.817E-005, .003] | .001 | .111 | 1.315 | .19 |
| Centered Handoff Quality | .057 [-.008, .124] | .032 | .136 | 1.750 | .08 |
| Centered Total Fatigue & Centered Handoff Quality | .002 [-5.268E-005, .004] | .001 | .113 | 1.379 | .17 |

**Note.** *B* = unstandardized regression coefficient; $SE_B$ = Standard error of the coefficient; β = standardized coefficient Bootstrap 95% Confidence Intervals reported in [].

***Additional Findings.*** Some MN nurses in each group worked in acute care hospitals that had obtained magnet status. An independent sample *t*-test was used to determine if there was a difference in fatigue levels and handoff quality among those who worked in a magnet facility versus those who did not. Working in a facility that had obtained magnet status did not reveal a statistically significant difference in chronic fatigue $t(133.87) = -1.340$, $p = .18$, $r = .1$, 95% CI [-13.15, 2.53], acute fatigue $t(144.58) = .371$, $p = .71$, $r = .03$, 95% CI [-4.88, 7.14], persistent fatigue $t(143.11) = -.092$, $p = .93$, $r = .007$, 95% CI [-77.00, 6.38], total fatigue $t(142.79) = -.577$, $p = .57$, $r = .05$, 95% CI [-7.69, 4.21], or handoff quality $t(113.04) = .232$, $p = .82$, $r = .02$, 95% CI [-.22, .28].

Maternal newborn nurses in the 12-hour shift group reported errors including infusing magnesium sulfate too quickly causing cardiac arrest, infusing wrong dosages of Oxytocin, bolusing undelivered patients with Oxytocin, documenting in wrong charts, mislabeling expressed breast milk, and programming patient controlled analgesia pumps incorrectly. MN nurses in the 8-hour shift group also reported errors including forgetting to administer antibiotics, administering the wrong medication, administering medications at incorrect times, administering medication via incorrect route causing patient to experience brief episode of dyspnea, bolusing incorrect dose of Magnesium Sulfate, forgetting to document completed blood work so newborn experienced second heel stick for blood work to be drawn second time, incorrect administration of medication to newborn for narcotic withdrawal causing excessive sleepiness. Nurses in both groups reported errors that could negatively affect patient outcomes. However, despite a lack of statistical significance, MN nurses in the 12-hour shift group reported more patient errors, near errors and medication errors.

Maternal newborn nurses in both groups completed a visual analog scale asking them to rate the percentage of errors and near errors they committed that they believed were due to fatigue or handoff. The MN nurses who worked 8-hour shifts reported they made more errors (M = 1.56, SD = 2.97) and near errors (M = 1.93, SD = 3.33) due to fatigue and handoff compared to the MN nurses who worked 12-hour shifts (M = 1.76, SD = 3.14 for errors and M = 1.94, SD = 3.62 for near errors). The difference between the two groups was not statistically significant for fatigue $t(128.38) = .535$, $p = .30$, $r = .05$, *or* handoff ($t(114.04) = 1.062$, $p = .15$, $r = .1$.

When Maternal newborn nurses in both groups completed a second visual analog scale asking them to rate the percentage of injuries and accidents each had experienced due to fatigue. Again, it was the MN nurses who worked 8-hour shifts who perceived more of their work-related injuries/accidents (M = 38.46, SD = 37.62) were related to fatigue compared to the MN nurses who worked 12-hour shifts (M = 25.39, SD = 36.29). The difference was statistically significant. This was confirmed with bootstrap. The difference, 13.47, BCa 95% CI [31.45, 40.14] was statistically significant $t(88.27) = 2.016$, $p = .02$, $r = .2$. This was also confirmed with a Mann-Whitney test. Median work-related injuries/accident scores for 8-hour shift nurses (35) and 12-hour shift nurses (1) were statistically significantly different, $U = 2005$, $z = -2.109$, $p = .02$, $r = -.2$.

The results of the visual analog scales are both interesting and concerning. The MN nurses in the 12-hour shift group experienced greater fatigue, reported more patient errors, and experienced more work-related injuries and accidents. However, they did not attribute their patient errors and work-related injuries and accidents to increased levels of fatigue. A study conducted by Scott, Arslanian-Engoren, and Engoren (2014) discovered

critical care nurses who worked 12-hour shifts were more likely to experience decision regret. Those who experienced decision regret "reported significantly more acute fatigue" (p. 17). The MN nurses in the 12-hour shift group who participated in this study experienced statistically significantly greater levels of acute and total fatigue. Their perception that they were able to function adequately even though they were making mistakes and experiencing injuries and accidents is concerning.

## Discussion

The purpose of this study was to determine the differences between 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) work-related fatigue and MN nurses' personal safety among MN nurses who work 8- and 12-hour shifts. MN nurses in the two groups worked similar hours in the two-week period reported in the study. MN nurses in both groups reported working extra hours and overtime that when added to the regular hours they were scheduled to work exceeded the total work hours recommended by both the Institute of Medicine (IOM) (2004) and the American Nurses Association (ANA, 2014).

The IOM (2004) recommended total hours worked should not exceed 12-hours in a 24-hour period or 60 hours in a seven-day period. The ANA (2014) also recommended total work hours should not exceed 12-hours in a 24-hour period, however, the ANA recommended total hours worked should not exceed 40 hours in a seven-day period. Regardless of the recommendation chosen to follow, MN nurses in both groups exceeded the recommendations. Sixty of the MN nurses in the 8-hour shift group and 49 of the MN nurses in the 12-hour shift group worked $\geq$ 80 hours in the two-week period reported in the study. Twenty-seven of those sixty MN nurses in the 8-hour shift group and eight of

the forty-nine MN nurses in the 12-hour shift group worked ≥ 120 hours in the two-week period reported during the study.

Even though many MN nurses in both groups exceeded the recommended work hours, the MN nurses who worked 12-hour shifts reported greater levels of fatigue, and more patient errors including medication and near errors. Errors that were reported included infusing magnesium sulfate too quickly causing cardiac arrest, infusing wrong dosages of Oxytocin, bolusing undelivered patients with Oxytocin, documenting in wrong charts, mislabeling expressed breast milk, and programming patient controlled analgesia pumps incorrectly. All of these can negatively affect patient outcomes. MN nurses who worked 12-hour shifts also reported experiencing more accidents and injuries (nurse harm) than nurses who worked 8-hour shifts. This study also showed total fatigue was highly significant for predicting patient errors. This information provides support for the work of Barker and Nussbaum (2011) who reported working longer shifts (greater than 12 hours) lead to greater levels of physical and total fatigue. This information also supports previous studies reporting an association with extra hours (Roger et al., 2004) and overtime (Olds & Clarke, 2010) with increased levels of fatigue. This study also supports previous studies (Trinkoff et al., 2008; Edwards et al., 2013, Johnson et al., 2010; Scott et al., 2010; Scott et al., 2007) that reported relationships between 12-hour shifts and more incidents of nurse accidents and injuries (nurse harm).

While total fatigue predicted more variance for patient errors, handoff quality predicted more variance for patient near errors. During handoff, one would expect the oncoming nurse to be rested and potentially more alert so it may be possible that the oncoming nurse noticed potential errors and prevented them from reaching the patient.

A study conducted by Chen, Davis, Daraiseh, Pan, and Davis (2014) reported nurses who worked in facilities that had successfully obtained or were trying to obtain magnet status experienced less fatigue (acute and chronic) than nurses who worked in facilities that did not have or were not trying to obtain magnet status. The results of the current study did not support their findings.

The study's theoretical framework was supported. The Hospital Nurse Force Theory postulated longer shifts lead to more fatigue and more incidents of patient error and nurse accidents and injuries (nurse harm). Handoffs, while not specifically discussed in the theoretical framework, were considered part of the hospital environment, which was a theoretical concept in The Hospital Nurse Force Theory. Previous studies indicated ineffective handoffs are instances where not all necessary patient information is reported to the oncoming nurse creating the potential for patient errors to occur which could ultimately harm patients (Ebright et al., 2004; Freisen et al., 2008; Reisenberg et al., 2010).

In 2009, one of the National Patient Safety Goals developed by the Joint Commission required healthcare facilities to improve handoff communication by implementing a standardized handoff process. Assuming many facilities had complied and developed a standardized handoff process to mitigate the risk associated with poor quality handoffs, this PI did not believe there would be a difference in the quality of handoff between the two groups. Whether facilities where study participants practiced had standardized handoff processes is unknown since those data were not collected.

Both fatigue and poor quality handoffs were significant predictors for patient errors and near errors. Since MN nurses who worked 12-hour shifts experienced greater

levels of fatigue (see Table 5) and made more patient errors (see Table 6), an argument can be made that 12-hour shifts are harmful for patients and their safety. MN nurses who worked 12-hour shifts also experienced more personal work-related injuries and accidents adding to the argument that 12-hour shifts are harmful. However, many of the nurses did not verbalize an awareness of the role their fatigue played in patient errors and work-related injuries/accidents. This is cause for concern and may be related to a lack of knowledge or understanding of fatigue and the negative effect it can have on them, their ability to provide safe patient care, and their ability to maintain personal safety. Maternal newborn nurses who worked 12-hour shifts might benefit from education about fatigue and its effect on them. Scott, Hofmeister, Rogness, and Rogers (2010) reported the use of a fatigue countermeasures program for nurses to manage fatigue. The program consisted of education on several topics including fatigue and ways to minimize fatigue. Nurses who participated in the fatigue countermeasures program experienced a decrease in drowsiness, motor vehicle accidents and near-miss motor vehicle accidents, and committed fewer patient errors and near errors (Scott et al., 2010).

Maternal newborn nurses might increase their understanding of fatigue and its effects if provided with evidence regarding their inability to function safely. This could be done by measuring psychomotor performance. Johnson, Brown, and Weaver (2010) measured the psychomotor performance of nurses who worked night shift using the d2 Test of Attention. They found nurses who were sleep deprived (fatigued) had poorer psychomotor performance than nurses who were not sleep deprived (not fatigued).

Working more than one job could lead to greater levels of fatigue. Among those who participated in the study, 21.4% of the nurses (n = 15) in the 8-hour shift group and

19.2% of the nurses (n = 29) in the 12-hour group reported working more than one job. The ANA (2014) recommends nurses work no more than five consecutive 8-hours shifts, no more than three consecutive 12-hour shifts, and no more than 40 hours per week. With the number of hours MN nurses reported working, it was obvious that some were far exceeding the current ANA recommendations. Even though some MN nurses in both groups worked more than one job, those who worked 12-hour shifts experienced more fatigue, made more patient errors and experienced more work-related injuries and accidents. Thus, an argument could be made for hospital administrators to restrict their nurses from working another job since doing so could increase their fatigue level negatively affecting their ability to provide safe patient care and potentially increasing their risk of sustaining a work-related injury or accident. Accidents and injuries that occur while working are typically covered by Worker's Compensation which has the potential to result in a budgetary strain for acute care facilities.

Knowing MN nurses who work 12-hour shifts experienced greater levels of fatigue and made more patient errors could be clinically significant for patients, their families and employers. Today, acute care facilities are required to report multiple quality measures as well as patient satisfaction scores, which are made available to the public (Centers for Medicare & Medicaid Services, 2015). Future patients can review this information and use it to determine which facilities provide quality care leading to better outcomes and greater patient satisfaction. This means facilities with poorer outcomes or low patient satisfaction scores could receive fewer patients, which could have a detrimental effect on their budget and their ability to keep their doors open.

With this information, it would seem logical to reduce the length of nurses' work

shifts to 8-hours. Among the MN nurses in the 12-hour shift group, 39% would prefer to work 8-hours shifts if that shift was available. On the other hand, 61% of the MN nurses who work 12-hour shifts did not indicate an interest in working 8-hour shifts.

For hospital administrators, requiring nurses to work 8-hour shifts would require more nurses since three work shifts would need to be covered instead of two shifts when nurses work 12-hours. Nurses are the largest employee group in acute care facilities so changing to 8-hour shifts could potentially increase recruitment and training costs creating budgetary issues for acute care facilities.

Requiring MN nurses to work 8-hours would mean working 5 days a week potentially 1) decreasing time with family and friends; 2) disrupting work-life balance; and 3) increasing the cost of child and/or elder care. It would also require patient handoffs three times a day. However, the results of this study showed there was essentially no difference in handoff quality between the two groups which could alleviate concerns about an additional handoff increasing patient errors.

Hospital administrators who are aware of the current body of research regarding nurses' work-related fatigue and the negative effect it has on patients' safety and nurses' personal safety should decide about whether to continue allowing nurses to work 12-hour shifts. Hospital administrators who are not aware of the current body of research should review it to become aware of the negative affect nurses' work-related fatigue has on patients' safety and nurses' personal safety. Hospital administrators who choose to allow nurses to continue to work 12-hour shifts should consider utilizing interventions to decrease the effects of fatigue to mitigate the known risks to patients and nurses. Those administrators who choose to require nurses to work 8-hour shifts need to determine a

standardized handoff method that will assure all pertinent patient information is passed from the off going nurse to the oncoming nurse so patients will not be at risk for injury or harm due to a poor quality handoff.

## Strengths and Limitations

A strength of this study is the national sample of maternal newborn nurses who were randomly selected to participate in the study. No previous studies were found in which the study population consisted of only MN nurses. Another strength is addressing a gap in the literature. No previous studies were found that addressed the difference in patient errors (patient safety) and nurses' accidents and injuries (nurse harm) that occur due to fatigue and/or handoff between MN nurses who 8- versus 12-hour shifts.

Another strength is the use of Likert scales and visual analog scales. Use of these scales allowed data to be summed to continuous level data enabling parametric testing of the hypotheses that met assumption testing.

Study limitations included potential recall bias and social desirability since participants were asked to self-report errors they made in the past that either harmed or had the potential to harm a patient, another nurse, or themselves. The anonymity of an online survey was an attempt at controlling social desirability, which was intended to allow participants to answer accurately versus what they perceived as the most desirable answer. Use of the OFER scale to calculate a total fatigue score has not been done in any previous research studies. By doing so in this study may be another limitation.

Because this study was specific to maternal newborn nurses, the results may not be generalizable to nurses who work in other acute care nursing departments. The sample was limited to AWHONN members so the findings may not be representative of all MN

nurses. In addition, most participants in both groups were female so the results of the study may not be generalizable to male nurses who work in maternal newborn areas.

An additional study limitation was not measuring variables such as nurse satisfaction, quality and quantity of sleep, life stressors outside of work including child/elder care, and geographical location. Although some MN nurses indicated they would have preferred to work 8-hour shifts if offered, nurse satisfaction was not actually measured. Quality and quantity of sleep, life stressors outside of work, and geographical location could have been measured since all have the potential to influence levels of fatigue and could be confounding variables for this study. However, due to the complexity of the issues and the PI's personal interest, the focus of this study was the impact of fatigue and ineffective handoffs on patient safety and nurses' personal safety.

## Future Recommendations

Maternal newborn nurses in both groups reported experiencing work-related fatigue but they may not have been aware of the role their fatigue played in patient errors and their own accidents and injuries. Numerous topics related to the issue of fatigue and handoff quality related to patient safety and nurses' personal safety are worthy of study. However, based on the findings of this study, future research needs to focus on nurses' awareness of fatigue and its contribution to patient errors and nurses' work-related injuries and accidents. One study could be a quantitative study to assess nurses' knowledge before and after receiving education about the effects fatigue has on patients' safety and their own personal safety in an attempt to reduce the incidence of patient errors and nurses' work-related injuries and accidents. A second study could be a qualitative study to discover MN nurses' beliefs/perceptions about the association

between patient errors and nurses' work-related injuries and accidents. A third study could investigate the impact fatigue has on nurse's psychomotor function to assist nurses in understanding the role fatigue has in patient safety and nurses' personal safety.

## Summary

The purpose of this study was to determine the differences between 8- and 12-hour shifts related to 1) work-related fatigue and patient safety; 2) nursing handoffs and patient safety; and 3) MN nurses' personal safety. Previous studies have demonstrated that fatigue may result from working long shifts (greater than 8 hours), and fatigue may lead to errors that can harm patients and nurses. This study supports those previous studies. Knowing this, it would seem logical to reduce the length of nurses' work shifts to 8-hours. However, doing so has implications for nurses and the possibility of decreasing nurse satisfaction as well as increasing the need for additional staff and the cost associated with having more staff. Moving to an 8-hour shift length would also require more patient handoffs. Studies showing more patient handoffs lead to a greater number of errors (impacting patient safety) than fatigue had not been found. This study found essentially no difference in handoff quality between the two groups. However, the hierarchical multiple regression analysis revealed that both poor quality handoffs and fatigue were statistically significant in predicting patient errors and near errors, but not nurse work-related injuries and accidents. More studies are needed to determine whether poor quality handoffs or nurse work-related fatigue are associated with more harm to patients and nurses' personal safety. Once that is known, changes could be then be made that have the potential to mitigate the risk of harm to patients and nurses.

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# Chapter 4

## Summary of Work

Interest in nurse work-related fatigue began long before this PI enrolled in the doctoral program at The University of Texas at Tyler. Personal experience with work-related fatigue and observing the effects work-related fatigue had on co-workers lead to a desire to investigate this phenomenon. Chapter two, *Nurse Fatigue: An Evidence Review*, provided a review of the literature focusing on acute work-related fatigue experienced by nurses who worked 12-hour shifts, the impact it had on nurses' personal safety and patient safety, measures to mitigate acute fatigue and areas in need of additional research. The goal was to examine the research that had already been conducted on nurse fatigue to learn what was already known about this topic, and to determine the need for additional research, if any.

Previous research indicated that long shifts (greater than 8 hours) had a negative effect on patient safety and nurses' personal safety. Several articles mentioned the need for additional research, but none of the articles investigated the differences between shift length (fatigue and handoffs), patient errors and nurses' personal safety among maternal newborn nurses.

Chapter three, *Impact of Nurse Fatigue and Nursing Handoffs on Patient and Nurse Safety*, investigated the differences between maternal newborn nurses who worked 8- versus 12-hour shifts, the level of fatigue each one experienced, their perception of handoff quality, incidence of patient errors and near errors and nurse work-related injuries and accidents. The results provided additional support to previous studies that had been conducted and also provided some new information. Maternal newborn nurses who work 12-hour shifts do experience more fatigue, make more patient errors and

experience more accidents and injuries than MN nurses who work 8-hour shifts. Essentially there was no difference in handoff quality between the two groups.

With that information in mind, the next steps would be to investigate what MN nurses believe/perceive is the cause of patient errors and near errors since only a few nurses in each group acknowledged the contribution fatigue and poor quality handoffs have in causing patient errors and near errors, and 2) investigate the impact fatigue has on MN nurses' psychomotor function.

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## Appendix A. Study Invitation

### Study Invitation

Would you like to have your thoughts and opinion heard? Have you ever been so tired after working that you arrived at home and wondered how you got there? Have you ever been so tired while working that you made a mistake? Have you ever received shift handoff and afterwards realized you were missing important information? Have you experienced a personal injury while at work? If yes, then I invite you to participate in a research study that will explore the relationships among shift length, patient safety and your personal safety.

To be eligible to participate in the study, you need to be:

1) Maternal newborn nurse who provides direct patient care
2) Member of the Association of Women's Health, Obstetric, and Neonatal Nurses
3) Employed full-time
4) Work 8-hour or 12-hour shifts
5) Have a minimum of one year of experience
6) Able to read and speak English
7) Free of any current or past history of sleeping disorders.

If you are willing to participate, click on the link to continue to the informed consent form. After reading the consent form, if you understand it, and agree to participate in this research study, continue to the survey questions by clicking on >> located in the lower right hand corner.

Thank you,

Melody A. Seitz

Melody A. Seitz, MS, RNC-OB
Principal Investigator
mseitz@patriots.uttyler.edu

# Appendix B. IRB Approval

**THE UNIVERSITY OF TEXAS AT TYLER**
**3900 University Blvd. • Tyler, TX 75799 • 903.565.5774 • FAX: 903.565.5858**

**Office of Research and Technology Transfer**

**Institutional Review Board**

December 19, 2015

Dear Ms. Seitz,

Your request to conduct the study*: Effect of Shift Length, Handoffs, and Fatigue on Patient and Nurse Safety,* IRB #F2015-39 has been approved by The University of Texas at Tyler Institutional Review Board as a study exempt from further IRB review. This approval includes a waiver of signed, written informed consent. 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**:

- 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.

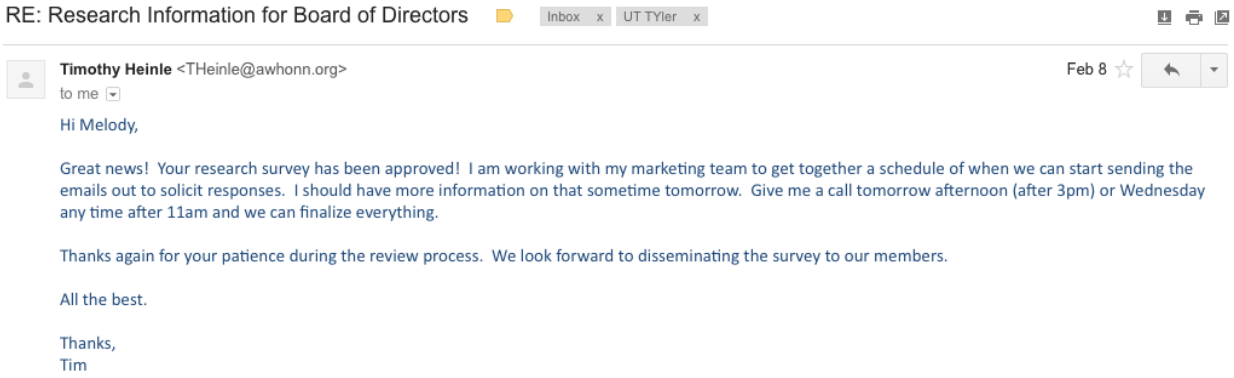
Best of luck in your research, and do not hesitate to contact me if you need any further assistance.

Sincerely,

Gloria Duke, PhD, RN

Gloria Duke, PhD, RN
Chair, UT Tyler IRB

# Appendix C. AWHONN Board of Directors Approval



RE: Research Information for Board of Directors

Inbox x UT TYler x

**Timothy Heinle** <THeinle@awhonn.org> Feb 8

to me

Hi Melody,

Great news! Your research survey has been approved! I am working with my marketing team to get together a schedule of when we can start sending the emails out to solicit responses. I should have more information on that sometime tomorrow. Give me a call tomorrow afternoon (after 3pm) or Wednesday any time after 11am and we can finalize everything.

Thanks again for your patience during the review process. We look forward to disseminating the survey to our members.

All the best.

Thanks,
Tim

Appendix D. Online Survey Consent Form

Online Survey Consent Form

You are being invited to participate in an online survey as part of a research study titled Effects of Shift Length, Handoffs, and Fatigue on Patient and Nurse Safety. This study is being conducted by Melody A. Seitz, MS, RNC-OB, a PhD in Nursing student from the University of Texas at Tyler. You were selected to participate in this study because you are a member of the Association of Women's Health, Obstetric, and Neonatal Nurses.

The purpose of this research study is to explore relationships among shift length, patient safety and nurses' personal safety. If you agree to take part in this study, you will be asked to complete an online survey. This survey will ask you to provide information about demographics, fatigue, your nursing department's nursing handoff process, and errors that may have been made by you unintentionally or intentionally that harmed or had the potential to harm a patient, yourself, or another nurse. It will take approximately 20 minutes to complete the survey.

Your survey answers will be stored in Qualtrics, a web-based survey software platform. Your identifying information such as your name, email address, or IP address will not be requested or collected. Therefore, your responses will remain anonymous. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study.

You may not directly benefit from this research; however, we hope that your participation in the study may assist in advancing nursing research on this topic.

We believe there are no known risks associated with this research study, however, some of the survey questions may cause some distress to you as you think about your experiences. I also understand that any information collected during this study may be shared as long as no identifying information such as my name, address, or other contact information is provided. Information may be shared with:

- Organizations giving money to support this study
- Other researchers interested in putting together your information with information from other studies
- Information shared through presentations or publications

I understand The University of Texas at Tyler Institutional Review Board (the group that makes sure that research procedures are in place to protect the safety of research participants) may look at the research documents. This is a part of their monitoring procedure. None of the documents has information that identifies me on them. This is a part of their monitoring procedure. I also understand that my personal information will not be shared with anyone.

Your participation in this study is completely voluntary. You may refuse to take part in the research or exit the survey at any time without penalty.

If you have questions about this project or if you have a research-related problem, you may contact the researcher, Melody A. Seitz, MS, RNC-OB at mseitz@patriots.uttyler.edu or (717) 244-5525 or dissertation committee chair, Dr. Susan Yarbrough, PhD, RN, CNE at syarbrough@uttyler.edu or (903) 565-5554.
If you have any questions concerning your rights as a research subject, you may contact Dr. Gloria Duke, Chair of the IRB, at (903) 566-7023, gduke@uttlyer.edu or the University's Office of Sponsored Research:

The University of Texas at Tyler
c/o Office of Sponsored Research
3900 University Blvd
Tyler, TX 75799

If you have read and understood this consent form and agree to participate in this research study, proceed to take the survey by opening the survey questions. Consent is implied when you open the survey questions.

Appendix E. Demographic Data Sheet

Demographic Data Sheet

1) What is your gender? ___ Female ___Male

2) What is your age? _____

3) How long (in years) have you been a registered nurse? _____

4) Do you work in a Magnet facility? ____Yes ___No

5) How many beds are on your unit? ___

6) In which maternal newborn nursing department do you currently work?

___ Labor and Delivery ___High Risk Obstetrics ___ Newborn Nursery

___Postpartum ___Mother/Baby ___Neonatal Intensive Care

7) Do you most often work 8-hour or 12-hour shifts? ___ 8-hours ___12-hours

8) If you work 8-hour shifts, what time do you work?

___ Day (7a-3p) ___ Evening (3p-11p) ___ Night (11p-7a) ___ Rotating

9) If you work 12-hour shifts, what time do you work?

___ Day (7a-7p) ___ Night (7p-7a) ___Rotating

10) How man shifts have you worked in the past 14 days? ____

11) How many of this shifts included extra hours or overtime? ____

12) What was the average number of extra hours and/or overtime worked per shift? ___

13) If you currently work 12-hour shifts, would you prefer you prefer to work 8-hour shifts if 8-hour shifts were available?

___ Yes ___ No If yes, why _____

14) Do you work more than one job? ___ Yes ___ No

15) If the answer to 14 was yes, how many hours per week do you work at the other job? ____

16) When working, do you get the opportunity to take a break(s) and/or eat meals free of patient care responsibilities?

___ No break or meal period ___Break and/or meal with patient care responsibilities

___ Break and/or meal free of patient care responsibilities

17) If you get the opportunity to take a break(s) and/or eat meals, how often does this occur?

___Once a shift ___Once a week ___Once a month

___Other, if select other please indicate how often you get the opportunity to take a break and/or eat meals _____

18) What is the average number of patients you typically care for over the course of your shift?

_____ Individual patients _____Mother/baby couplets

Appendix F. Notable Events Recall Report

Notable Events Recall Report

1) How many errors (any preventable event, mistake, or inadvertent occurrence that harms or has the potential to harm the patient such as, medication, documentation, treatment, communication) have you made in the last twelve months? _____

2) How many of the errors cited above were medication errors? _____

3) How many near errors (an error that happened but did not reach the patient) have you made in the last twelve months? _____

4) How many work-related injuries/accidents have you experienced in the last twelve months? _____

5) On a visual analog scale of 0% to 100%, rate the following statements:

I believe ____% of errors/near errors I have made are related to fatigue.

0% ——————————— 100%

I believe ____% of errors/near errors I have made are related to handoff.

0% ——————————— 100%

I believe ____% of personal injuries/accidents I have experienced are related to fatigue.

0% ——————————— 100%

| Please describe an incident when an error occurred that harmed or had the potential to harm a patient, you, or another nurse. (Optional) |
|---|

Appendix G. Occupational Fatigue Exhaustion Recovery Scale

Occupational Fatigue Exhaustion Recovery (OFER) Scale

These Statements are about your experience of FATIGUE and STRAIN at Work and Home OVER THE LAST FEW MONTHS

**Circle a number from 0-6: "Strongly Disagree" to "Strongly Agree" which best indicates your response.**

| | Strongly Disagree | Disagree | Slightly Disagree | Neither Agree or Disagree | Slightly Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1) I often feel I'm 'at the end of my rope' with my work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2) I often dread waking up to another day of my work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3) I often wonder how long I can keep going at my work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4) I feel that most of the time I'm just "Living to Work". | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5) Too much is expected of me in my work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 6) After a work shift I have little energy left. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7) I usually feel exhausted when I get home from work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 8) My work drains my energy completely every day. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 9) I usually have lots of energy to give to my family or friends. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 10) I usually have plenty of energy left for my hobbies and other activities after I finish work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 11) I never have enough time between work shift to recover my energy completely. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 12) Even if I'm tired from one shift, I'm usually refreshed by the start of the next shift. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13) I rarely recover my strength fully between work shifts. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 14) Recovering from work fatigue between work shifts isn't a problem for me. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 15) I'm often still feeling fatigued from one shift by the time I start the next one. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

Appendix H. Handover Evaluation Scale

Handover Evaluation Scale

Perceptions of Handover

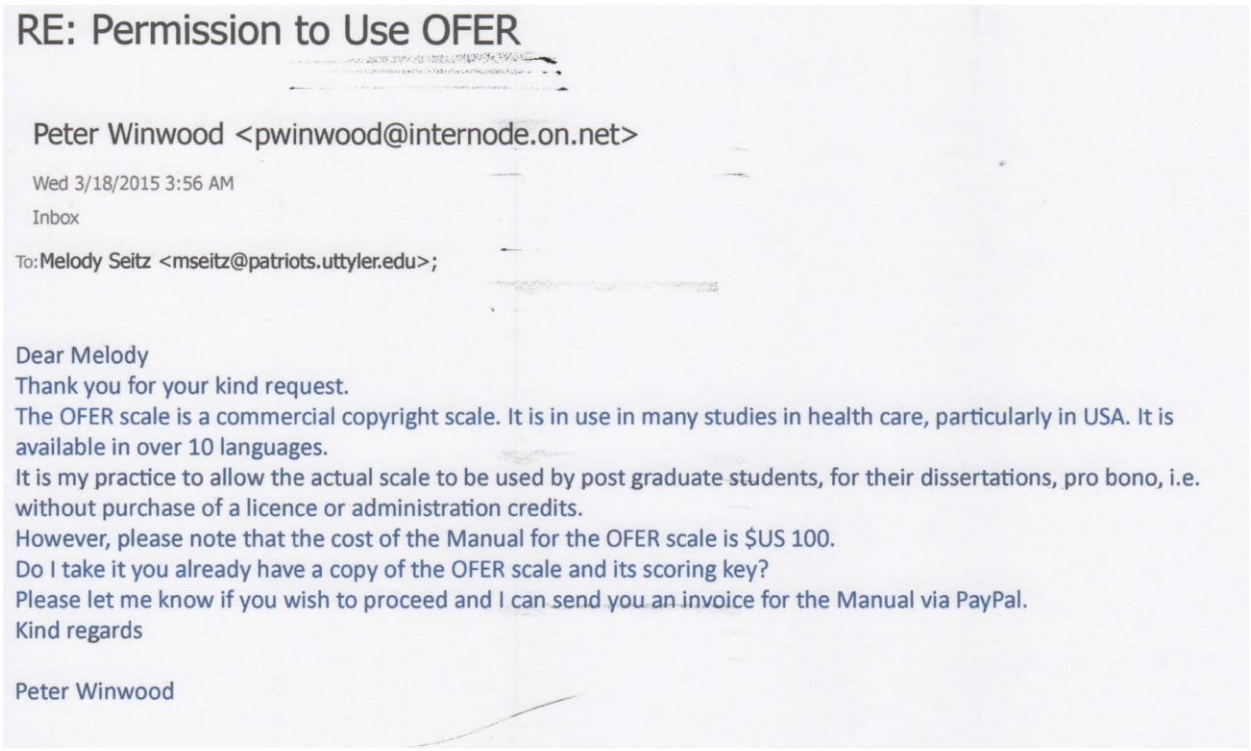
Handover (also known as handoff) can have several purposes including the transfer of patient information, staff debriefing, support, and nurse education.
Please indicate the extent to which you disagree or agree with the following statements from the perspective of a nurse starting a shift on your current nursing department.

**Circle a number from 0-6: "Strongly Disagree" to "Strongly Agree" which best indicates your response.**

| | Strongly Disagree | Disagree | Slightly Disagree | Neither Agree or Disagree | Slightly Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1) I have the opportunity to discuss difficult clinical situations I have experienced. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2) I am provided with sufficient information about patients. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3) I have the opportunity to debrief with other colleagues when I have a difficult shift. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4) I have the opportunity to discuss workload issues. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5) I am often given information during handover that is not relevant to patient care. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 6) The way in which information is provided to me is easy to follow. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7) I am able to clarify information that has been provided to me. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 8) Patient information is provided in a timely fashion. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 9) I have the opportunity to ask questions about things that I do not understand. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10) I find handover takes too much time. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 11) The information that I receive is up-to-date. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 12) I am able to keep my mind focused on the information being given to me. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 13) I am educated about different aspects of nursing care. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 14) I feel that important information is not always given to me. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

Appendix I. Letters of Permission for Use of Instruments



RE: Permission to Use OFER

Peter Winwood <pwinwood@internode.on.net>

Wed 3/18/2015 3:56 AM

Inbox

To: Melody Seitz <mseitz@patriots.uttyler.edu>;

Dear Melody
Thank you for your kind request.
The OFER scale is a commercial copyright scale. It is in use in many studies in health care, particularly in USA. It is available in over 10 languages.
It is my practice to allow the actual scale to be used by post graduate students, for their dissertations, pro bono, i.e. without purchase of a licence or administration credits.
However, please note that the cost of the Manual for the OFER scale is $US 100.
Do I take it you already have a copy of the OFER scale and its scoring key?
Please let me know if you wish to proceed and I can send you an invoice for the Manual via PayPal.
Kind regards

Peter Winwood


MonashHealth

*Centre for Nursing Research – Deakin University and Monash Health Partnership*

Melody A. Seitz
PhD candidate
University of Texas
7th September 2015

Dear Melody,

Thank you for your interest in our handover research and, in particular, our staff survey.

We hereby provide you with permission to use our survey. We also provide you with permission to make minor modifications to the survey, as necessary, to suit your local context.

Our original work using this survey was published in 2008 [O'Connell, B., Macdonald, K., & Kelly, C. (2008). Nursing handover: It's time for a change. Contemporary Nurse, 30(1), 2-11]. Since then we have conducted further analyses to establish the psychometric properties of the survey. A second paper was published in the Journal of Clinical Nursing and we suggest that you include this reference when acknowledging the source of the survey. We have not made any changes to the survey since this publication.

Please find attached a PDF copy of the survey which is titled the Handover Evaluation Scale (HES). Our recent analysis has focused on Section C: Perceptions of Handover.

If you would like further information, please contact me via email: beverly.oconnell@ad.umanitoba.ca.

Kind regards,

Dr Bev O'Connell

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Biographical Sketch

NAME: Seitz, Melody Ann

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: MS, RNC-OB, Assistant Professor

EDUCATION/TRAINING

| INSTITUTION AND LOCATION | DEGREE | MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| York College of Pennsylvania | BSN | 05/1990 | Nursing |
| Regis University | MS | 05/2009 | Nursing Education |
| The University of Texas at Tyler | PhD | Candidate | Nursing |

## A. Personal Statement

The goal of the proposed research was to determine which shift length, 8- or 12-hours, was associated with more harm to patients and MN nurses. Differences in patient errors including medication and near errors, nurses work-related injuries and accidents, handoff quality and levels of chronic, acute, persistent and total fatigue were examined. During my 30 years of working as a nurse, I experienced fatigue while working, a near miss automobile accident on my way home after working a 12-hour night shift and have made errors and near errors. In addition to my personal experiences, I also witnessed the impact of fatigue on co-workers. All of this combined gave me the wherewithal to conduct this study.

## B. Positions and Honors

### Positions and Employment

2016 – Present. Assistant Professor, School of Nursing, Notre Dame University of Maryland, Baltimore, MD
2013 – Present. Adjunct Faculty, Department of Nursing, Messiah College, Mechanicsburg, PA
2011 – 2016. Adjunct Faculty, School of Nursing, Johns Hopkins University, Baltimore, MD
2005 – Present. Clinical Nurse Educator, Greater Baltimore Medical Center, Baltimore, MD

### Other Experiences and Professional Memberships

Sigma Theta Tau International Honor Society of Nursing
Association of Women's Health, Obstetric, and Neonatal Nurses
Pennsylvania State Nurses Association
American Nurses Association
Fetal Infant Mortality Board for Baltimore County
Eastern Nursing Research Society