AN EVALUATION OF FATIGUE MANAGEMENT STRATEGIES IMPLEMENTED ON HOSPITAL NURSING UNITS

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A project submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice in the Doctor of Nursing Practice Program in the School of Nursing.

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ABSTRACT

Christa W. Seaman: An Evaluation of Fatigue Management Strategies Implemented on Hospital Nursing Units
(Under the direction of Cheryl B. Jones)

Nursing staff are often scheduled to work long shifts, rotate between day and night shifts, and work overtime to help hospitals ensure delivery of care to patients around the clock, as well as provide nurses work-life balance by giving them more "leisure" or free time away from work. These schedules, now commonplace in hospitals, may unfortunately result in fatigue and sleep deprivation among nurses, negatively affect their work performance by decreasing productivity at work, and, more importantly, make them prone to errors that negatively impact the delivery of safe, quality patient care. This project used a pretest-posttest design to evaluate the effects of fatigue management strategies (namely, duty free breaks, limiting consecutive hours worked, and limiting consecutive shifts) implemented on four adult medical or surgical units at one large academic medical center. Measures used in evaluating the strategies implemented included the Occupational Fatigue Exhaustion Recovery (OFER15) instrument (Winwood et al., 2006), the Pittsburgh Sleep Quality Index (PSQI) instrument (Buysse et al., 1989), medication administration record near miss alerts, absenteeism, and overtime. The major project findings included a significant decrease in reported acute fatigue and an increase in sleep quality among the nursing assistive personnel following the implementation of fatigue management strategies. Additionally, staff on one of the four intervention units reported a significant increase in inter-shift recovery and an improvement in sleep quality following the implementation of fatigue management strategies.

To my friends and family who supported me on this journey in big ways and in small ones. Especially, my mom who became my full-time (and sometimes live in) nanny, chef, assistant, and personal cheerleader when I was knee deep into school with a newborn. And to my husband and son for the sacrifices you made during this program.

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CHAPTER 1

INTRODUCTION

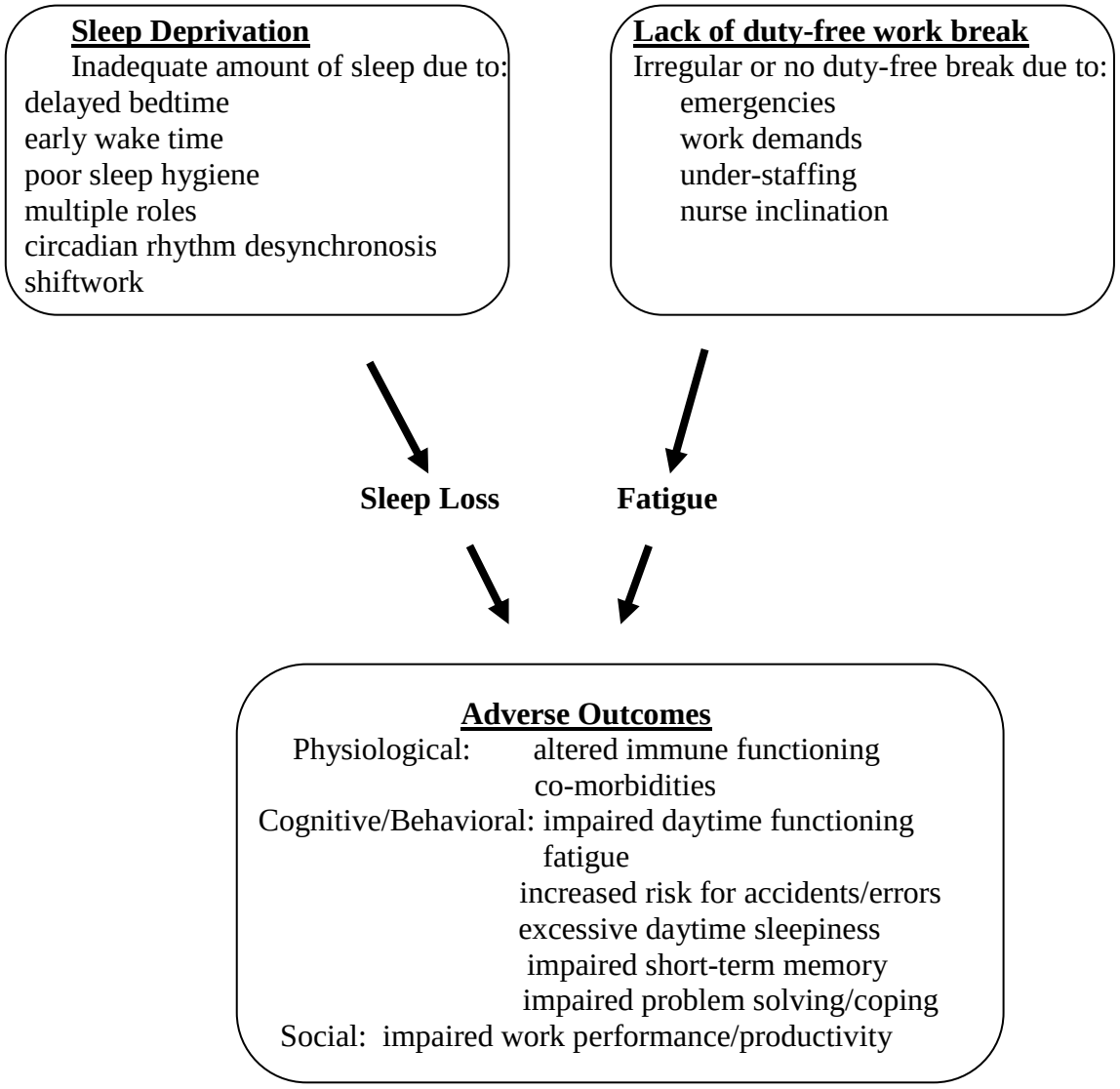
Nurses and nursing assistive personnel represent more than half of all health care workers in the United States and are the most common health care providers encountered in a hospital (Institute of Medicine, 2004; Page, 2008). The Institute of Medicine's (IOM) report in 2004, Keeping Patients Safe, recognized the critical role that nursing staff play in patient safety, and identified long work hours (shifts exceeding 12 hours) and associated work-related fatigue as one of several threats to patient safety (Institute of Medicine, 2004; Page, 2008). The 12-hour shift is popular among nursing staff because it gives them a three-day work week and flexibility in scheduling. Indeed, 2009 poll of 14,000 nurses conducted by the American Nurses Association (ANA) found that 59.4% of respondents worked 12-hour shifts (Witkoski & Vaughan Dickson, 2010). However, long shifts may lead to fatigue and adverse consequences. Further, a 12-hour shift may be lengthened due to unanticipated emergencies or other unexpected events such as increased patient acuity, staffing changes, inter-shift report, unfinished patient care, or paperwork (Stimpfel, Sloane, & Aiken, 2012; Trinkoff et al., 2006), causing more fatigue.

Fatigue commonly associated with nurses' work includes physical, cognitive, emotional, and sensory components that result from excessive work demands and insufficient recovery periods (Smith-Miller, Curro, Shaw-Kokot, & Jones, 2014). Nurses' work-related fatigue has been attributed not only to extended work shifts, but also to the ongoing and complex demands of care giving, the high level and intense nature of the skills required, and environmental factors

(e.g., noise and interruptions), as well as a disruption in circadian rhythms that may result from working night shifts, and impaired sleep or sleep deprivation (Graves & Simmons, 2009; Barker & Nussbaum, 2011; Phillips & Moffett, 2014). Day-night rotating schedules are common in fulfilling the 24-hour patient care responsibilities in many inpatient settings. However, working regular rotating shifts and inadequate inter-shift recovery, particularly a night-to-day rotation, can lead to disruptions in circadian rhythm and chronic fatigue (Hakola, Paukkonen, & Pohjonen, 2010; Winwood, Winefield, & Lushington, 2006).

Nurse fatigue bas been linked to poor work performance, including slowed reaction time, memory lapses, delayed information processing, and lack of attention to detail (Campbell, et al., 2011; Garrett, 2008; Graves & Simmons, 2009; Institute of Medicine, 2004; Page, 2008). Further, studies indicate that fatigue can have a negative impact on the health of individuals and can contribute to absenteeism, burnout, and dissatisfaction (Garrett, 2008; Keller, 2009; Stimpfel, Sloane, & Aiken, 2012). Lee and colleagues argue that industries operating 24-hours a day and 7-days a week lead individuals to develop "sleep debt", or chronically restricted sleep patterns and a poor sleep quality due to a disrupted, irregular schedule. Their model of impaired sleep suggests that sleep loss with sleep deprivation or sleep disruption can lead to adverse physiological outcomes (e.g., altered immune function and co-morbidities), cognitive/behavioral outcomes (impaired problem solving or impaired short-term memory), emotional outcomes (e.g., altered mood or low motivation), and social outcomes (e.g., impaired interactions or impaired performance) (Lee et al., 2004). This model has been used as framework to examine fatigue in nurses (e.g., Scott, Arslanian-Engoren, & Engoren, 2014; Scott, Hofmeister, Rogness, & Rogers, 2010). The model of impaired sleep was modified to provide a conceptual framework for this project.

Figure 1. Conceptual Framework. This figure illustrates the model of impaired sleep (Lee et al., 2004) modified to inform this project.



Project Purpose

Although fatigue has been associated with negative patient, staff and organizational outcomes, health care organizations continue to schedule nursing staff to work long shifts, overtime, and rotating shifts to meet patient care needs around the clock and to meet nursing

staff work preferences (Berger et al., 2006; Johnson, Jung, Brown, Weaver, & Richards, 2014; Niu et al., 2011; Pilcher & Huffcutt, 1996). However, the IOM and The Joint Commission have called for organizations and state regulatory bodies to assess employee fatigue risk, develop policies to address extended work hours and overtime, and implement fatigue management measures (Institute of Medicine, 2004; Page, 2008; The Joint Commission, 2011). Nurse leaders are often challenged as they attempt to implement fatigue management strategies because of the need to meet patient care demands and nursing staff preferences for 12-hour shifts and self-scheduling. Clearly, nursing leaders need creative, healthy, and safe work environment strategies that minimize nursing staff fatigue while maintaining nurse satisfaction and retention (Lothschuetz & Geiger-Brown, 2010; Scott, Hofmeister, Rogness, & Rogers, 2010).

Fatigue management involves strategies or interventions aimed at preventing or alleviating worker fatigue. To date, however, only three studies have examined the impact of fatigue management interventions on sleep quality and patient care errors. The first study reviewed evaluated an educational initiative, the second limited work to 12 consecutive hours, and the third evaluated breaks or meal periods (Rogers, Hwang, & Scott, 2004; Scott, Hofmeister, Rogness, & Rogers, 2010; Warren & Tart, 2008).

This project evaluated the effects of fatigue management strategies on key staff, patient, and unit outcomes implemented on four inpatient nursing units. Nursing outcomes included perceived work-related fatigue and sleep quality. The patient outcome measured was unit-level medication administration record (MAR) near miss alerts. Unit performance outcomes were absenteeism and overtime.

CHAPTER 2

REVIEW OF LITERATURE

A review of literature was conducted using the Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and Web of Science (ISI). Key words used to target relevant literature were fatigue, nurse fatigue, work-related fatigue, error, performance, fatigue scale, sleep deprivation, sleep quality, and shift-work. Systematic reviews, randomized trials, research studies, instrument evaluations, and theory papers were retrieved. The literature was categorized by three major content areas: work-related fatigue in nursing staff, the relationship between fatigue and work performance, and fatigue management.

Work-Related Fatigue in Nursing Staff

Nurses are vulnerable to fatigue because extended work shifts (greater than 12-hours), overtime, and day-night rotating schedules continue to be used in most inpatient health care settings to provide round-the-clock care to patients (Campbell et al., 2011; Keller, 2009; Geiger-Brown & Trinkoff, 2010; Institute of Medicine, 2004; Page, 2008; Witkoski & Vaughan Dickson, 2010). In the late 1970s, nursing shifts were lengthened from 8 hours to 12 hours to meet patient care demands and retain nurses during a nursing shortage. In 2009 the American Nurses Association (ANA) conducted a poll of 14,000 nurses which found that 59.4% of nurses continued to work 12-hour shifts (Witkoski & Vaughan Dickson, 2010). Although nurses are generally satisfied with 12-hour shifts, because they can work fewer shifts per week, research suggests that nurses working these shifts are unable to fully recover physically or cognitively

between consecutive 12-hour shifts, due to inadequate sleep (Eldevik, Flo, Pallesen, & Bjorvatn, 2013; Geiger-Brown et al., 2012).

Research also indicates that nurses commonly work longer than the 12-hour scheduled shifts. In an exploratory study of 502 full-time critical care nurses providing direct patient care, Scott, Rogers, Hwang, and Zhang (2006) found, that nurses worked longer than scheduled for 86% of the shifts examined over a 29 day period and on average worked 49 minutes beyond their scheduled shift. All but one of the study participants also worked overtime at least once during the 28-day study period, and more than half (60.8%) worked overtime 10 or more times during the 28 days. In another study of 393 hospital staff nurses, Rogers, Hwang, Scott, Alken, and Dinges (2004) found that less than 20% of nurses reported leaving work at the end of their scheduled shift, and on average they worked 55 minutes beyond their scheduled shift. A fourth of the study participants worked more than 50 hours per week in two or more weeks of the four-week study period (Rogers, Hwang, Scott, Alken, & Dinges, 2004).

In a study of 1280 hospital staff nurses, Winwood, Winefield, and Lushington (2006) found chronic fatigue to be higher when nurses worked consecutive shifts or rotating shifts. They also found that participants working permanent night shift had poor high scores on chronic fatigue and low scores on recovery between shifts.

Fatigue and Performance

Extended periods of wakefulness (e.g., 17 hours) have been shown to decrease performance similarly to a blood alcohol concentration of 0.05 percent, or alcohol intoxication (Dawson & Reid, 1997; Lamond & Dawson, 1998; Institute of Medicine, 2004). Further research has also found that fatigue or sleep deprivation was associated with poor work performance (Berger et al., 2006; Johnson, Jung, Brown, Weaver, & Richards, 2014; Niu et al.,

2011; Pilcher & Huffcutt, 1996), exhibited as slowed reaction time, memory lapses, slowed information processing, inattention to detail, and attentional failures or absent mindedness. Poor performance may contribute to errors, adverse events, or occupational incidents, and may also decrease productivity (Berger et al., 2006; Campbell et al., 2011; Garrett, 2008; Geiger-Brown & Trinkoff, 2010; Graves & Simmons, 2009; Johnson, Jung, Brown, Weaver, & Richards, 2014).

For example, Rogers, Hwang, Scott, Aiken, and Dignes (2004) found that nurses were 3 times more likely to make an error when working 12.5 or more hours in a shift. In a study of 393 hospital staff nurses, these authors reported 199 errors and 213 near misses, and 58% and 56%, respectively, of these involved medication administration. A subsequent study found that the risk for making an error almost doubled when nurses worked 12.5 or more hours in a shift (Scott, Rogers, Hwang, & Zhang, 2006).

The number of errors and near errors has also been shown to increase when the hours worked per week exceeds 40 (Rogers, Hwang, Scott, Aiken, & Dignes, 2004; Scott, Rogers, Hwang, & Zhang, 2006). Olds and Clarke (2010) found that not only was there an increased likelihood of observing or making a medication error when nurses worked more than 40 hours per week, but other adverse events such as patient falls with injury increased as well.

Fatigue Management

Fatigue management involves strategies or interventions aimed at preventing or alleviating worker fatigue. To date, however, only three studies have examined the impact of fatigue management interventions on sleep quality and patient care errors. Using a prospective, one group pretest–posttest repeated-measures design, Scott, Hofmeister, Rogness, and Rogers (2010) evaluated a Fatigue Counter Measures Program for nurses (FCMPN) with a sample of 62 full-time hospital staff nurses recruited from medical-surgical units in three large Michigan

institutions. The FCMPN consisted of an education session for nurses about fatigue, adoption of adequate staffing on study units to relieve staff during breaks and meals, and availability of sleeping accommodations for staff to take naps during breaks or meal periods. The education session covered fatigue, sleep, circadian rhythms, neurobehavioral and health effects associated with sleep loss, and common misconceptions about sleepiness. Knowledge obtained from the educational session was assessed through a test, and were reviewed to reinforce fatigue-related content.

Data were collected for 2 weeks prior to the intervention, during the 4-week intervention, and at 12-weeks post-intervention. Nurses' sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and level of sleepiness was measured using the Epworth Sleepiness Scale (ESS) intervention. Daily logbooks were used to collect scheduling data, work hours, breaks, sleep and wake patterns, nurses' ability to stay awake while at work, errors, errors found, and near misses. The investigators found that after the FCMPN was implemented, there was an increase in the average number of sleep hours and a decrease in the severity of daytime sleepiness. The number of errors also decreased and the number of intercepted or discovered errors increased (Scott, Hofmeister, Rogness, & Rogers, 2010).

Warren and Tart (2008) evaluated the impact on surgical charting errors of a reduced call schedule that limited nurses and surgical technologists to working 12 consecutive hours. Weekday, weekend, and back-up call teams were formed and assigned to cover urgent and emergency cases on off-shift hours. No team was allowed to work more than 12 consecutive hours without calling for relief. Study participants included 24 operative room staff (nurses and surgical technologists) at a 258 bed community hospital. The investigators collected data for 3 months pre and post intervention implementation on type of OR procedure being covered by

staff, the procedure start and finish times, the shift worked, unit from which patients originated, patient demographics, day of week, and charting errors and type. The total number of charting errors was reduced by 26% after the reduced call schedule was implemented (Warren & Tart, 2008).

Rogers, Hwang, and Scott (2004) examined the relationship between skipping breaks or meal periods and adverse effects on patient safety. A random sample of 891 eligible members of the American Nurses Association were mailed two log books to record hours worked, meal and break periods, whether the nurse was released from duties during the break or meal, and errors or near errors that might have occurred. A total of 362 participants returned both log books, and 31 returned one of the two log books. Respondents indicated not having the opportunity for a break or meal on 10% of the 5,211 shifts examined. Respondents further received a break or meal period free of responsibility or patient care on less than half of the shifts examined (47%). The authors reported that although the absence of a break did not increase the risk of making an error, longer durations for breaks or meal periods did offer some protection against making an error. A 10% decrease in risk of making an error was found when a nurse had an additional 10 minutes for a break or meal period. On shifts without errors, nurses reported a break or meal period averaging 23.8 minutes, while on shifts with errors, nurses reported a break or meal period averaging 16.2 minutes (Rogers, Hwang, & Scott, 2004).

In summary, longer shift length, overtime, and rotating shifts are used to provide around the clock inpatient care and provide nursing staff with greater scheduling flexibility, but these can make nursing staff more susceptible to sleep deprivation and fatigue when they are unable to recover between shifts. In turn, sleep deprivation and fatigue can negatively impact staff work performance, and thus nurses' ability to provide safe, quality patient care. Although many

studies recommend that fatigue management strategies for nursing staff be considered, only three studies have reported the outcomes of organizational interventions to decrease fatigue in nursing staff, and none examined the sustainability or long-term effects of the interventions. These gaps suggest that additional work is needed to make use of the evidence that exists, and fill the gap in knowledge.

CHAPTER 3

METHODOLOGY

Project Design

This project was designed to evaluate the effects of fatigue management strategies implemented on four inpatient nursing units at a large academic medical center in the southeast on nursing staff, patient, and unit outcomes. Data on nursing staff demographics, perceived work-related fatigue, inter-shift recovery, and perceived sleep quality were gathered before and after the implementation of the strategies. Data on patient outcomes (MAR near miss alerts) and unit outcomes (absenteeism and overtime work) were gathered for 4 weeks before the implementation of fatigue management strategies, during the 12-week intervention period, and for 4 weeks following implementation of the strategies.

Setting and Sample

The project was conducted in an 803-bed academic medical center in the Southeast. The healthcare system includes 8 hospitals located throughout the state. The site's Nursing Practice Council (NPC), was charged with proposing measures to reduce nursing staff fatigue on inpatient units. Baseline work-related fatigue level data were gathered from all inpatient nursing staff, including registered nurses (RNs), nursing assistants, and health unit coordinators, using The Occupational Fatigue Exhaustion Recovery (OFER15) scale (2005). This instrument also assesses recovery between consecutive work shifts (Winwood, Lushington, & Winefield, 2006). In addition, the NPC collected information on specific unit fatigue management measures in

place, and assessed nurse managers' willingness for their unit to participate as an intervention site.

Four inpatient units were identified agreed to take part in the project. All were general adult surgical or medical acute care inpatient units, but they varied in size and patient population. All nursing staff employed on these four units were invited to take part in the study (estimated to be ~ 220 RNs, nursing assistants and nursing assistive personnel [NAP]). *Appendix* A displays the intervention unit code, the level of care provided by each unit, the number of beds on each unit, and the numbers of personnel employed on each unit at the time of this project in table format. The numbers of currently employed personnel on each unit was broken down into full time equivalents (FTEs) dedicated to each unit (RN and NAP); permanent, full time nurses; permanent, part-time nurses; per diem nurses; permanent, full time nursing assistive personnel; and per diem nursing assistive personnel.

The Intervention

The fatigue management strategies implemented were selected by the project site's nursing leaders, in collaboration with the NPC, following an extensive review of the literature (Smith-Miller et al, 2014). The strategies implemented included having duty free breaks (Rogers, Hwang, & Scott, 2004), limiting consecutive hours worked (Eldevik, Flo, Pallesen, & Bjorvatn, 2013; Olds & Clarke, 2010; Rogers, Hwang, Scott, Aiken, & Dignes, 2004; Scott, Rogers, Hwang, & Zhang, 2006; Warren & Tart, 2008), and limiting consecutive shifts (Geiger-Brown et al., 2012; Institute of Medicine, 2004). The 12-week intervention paralleled two 6-week nursing unit schedules to ensure feasibility in scheduling. The four intervention units care for different patient populations, operate with differing unit cultures, and are managed with diverse practices. Thus while the intervention was initiated on all four units, compliance with the intervention

differed on these units. The nurse manager or designee(s) was responsible for implementation of the fatigue management strategies on the unit, since future initiatives to implement similar strategies would fall to the nurse manager or designee(s) to implement. The nurse manager or designee(s) of each unit was asked to disclose how the unit intended to ensure compliance with the intervention. Table 1 lists the components implemented as part of each fatigue management strategy.

Table 1

Fatigue Management Strategies

Strategy	Components
Duty-Free Break	• 30-minute break within the first 8 hours of the shift • Phones and other electronic devices were passed off from the staff member taking a break to another designated staff member, who assumed patient care responsibilities during the break period. • designated 'break area' provided • Break time was considered "off limits" to interruption except for patient/staff/unit emergency. The break room door was closed, and a "do not disturb" feature activated on the break room phone.
Limiting Consecutive Work Hours	• Staff were scheduled to work no more than 12.5 hours per day except for patient/staff/unit emergencies. • Staff were scheduled for no more than 60 hours in a 7-day period.
Limiting Consecutive Work Shifts	• A minimum of 48 hours was scheduled when changing from night to day shift rotations. • Staff were scheduled for no more than five consecutive 12-hour shifts in a 7-day period.

Before the interventions were implemented, a meeting was scheduled with the nurse managers and their designees (unit leadership team member(s) identified by the nurse manager), along with the principal investigator, the project site's nurse researcher, the NPC chair, and the

NPC nursing director liaison. Nurse managers and unit leaders were given detailed instructions regarding the fatigue management strategies to be implemented, the timeline, and the assessments to take place before, during, and after the implementation of fatigue management strategies.

Variables and their measurement

Demographic information was collected pre and post implementation of fatigue management strategies in a survey comprised of 19-items, participants were asked to provide information about their age, type of position, nursing unit on which they were employed, number of years in role, type of education, secondary employment, number of hours spent at a second job if applicable, typical work schedule, and consistency of schedule. In the post-implementation survey, a question asking if the participant was currently a student was added. See *Appendix* B for the survey distributed.

As part of the survey, Occupational Fatigue Exhaustion Recovery (OFER15) instrument (Winwood et al., 2006) was used to measure work-related fatigue among nursing staff pre and post implementation of the fatigue management strategies. The OFER15 is a 15-item scale with three subscales: chronic fatigue (5 items), acute fatigue (5 items), and inter-shift recovery (5 items). The chronic fatigue subscale items are designed to capture mental, physical, and emotional components that are characteristics of persistent fatigue. The acute fatigue subscale captures inability or unwillingness to engage in activities outside the workplace as a direct consequence of previous activity. The inter-shift recovery subscale measures the extent to which the respondent perceives to have recovered from acute work-related fatigue before the next work shift. Items are scored on a Likert-type scale, with response options ranging from 0 to 6 (0 = strongly disagree, 6 = strongly agree). Scoring is completed for each subscale and produces

values between 0-100 for each. Scoring is completed by summing the item Likert responses, dividing by 30 and multiplying by 100 (e.g. OFER-acute fatigue = sum of items 6-10/30x100). Higher scores on the chronic and acute fatigue subscales indicate more fatigue, while a higher score on the inter-shift recovery subscale indicates more recovery between work shifts. Instrument authors report reliabilities of the three subscales, on Cronbach's α coefficients, of 0.84 for the acute fatigue and inter-shift recovery subscales and 0.86 for the chronic fatigue subscale. The OFER has been validated to measure work-related fatigue in several populations including nurses (Winwood, Lushington, & Winefield, 2006; Winwood, Winefield, Dawson, & Lushington, 2005).

Sleep Quality among nursing staff was also measured pre and post implementation with The Pittsburgh Sleep Quality Index (PSQI) survey (Buysse et al., 1989), a 19-item survey with six subscales: sleep duration, sleep disturbance, sleep latency, day dysfunction, habitual sleep efficiency, and sleep quality. Items 1 -4 are open ended questions and items 5 – 19 and scored on a Likert-type scale, with response options ranging from 0 to 3 (0 = not during past month or no problem, and 3 = three or more times a week or a big problem). Higher scores on each subscale indicate more sleep disturbances. To calculate total score, subscale scores are summed producing a score of 0 to 21 (0 = better, 21 = worse). A total score or PSQI of equal or less than 5 is associated with good sleep quality and a score greater than 5 is associated with poor sleep quality (Buysse, D., Reynolds, C., Monk, T., Berman, S., & Kupfer, D., 1989). Developers have reported test-retest reliability of 0.85 for the overall score, sensitivity of 89.6% and specificity of 86.5%. An reliability of 0.83 (Cronbach's α) has been reported with various populations (Buysse et al., 1989; Shahid et al., 2012). See *Appendix* C for permission to use PSQI instrument.

Survey participants were asked to anonymously generate identification codes based on information that was well known to the participant, but unknown to the principal investigator. Information was used to generate codes that could be easily recovered and were unlikely to be duplicated across multiple respondents. These identification codes allowed the principal investigator to link pre-post intervention surveys to measure change while maintaining participant anonymity (Damrosch, 1986).

Medication administration record (MAR) near miss alerts were used to measure near misses and potential errors in medication administration. The project site uses an integrated electronic health record, EPIC, which includes the patient's MAR. A near miss alert is generated automatically by the electronic health record software when the dose entered to be administered differs from the dose ordered, a medication is given off schedule, no active orders are found for the medication scanned, or no administrable orders are found for the medication scanned. The numbers of MAR near miss alerts are reported per 10,000 administrations. The numbers of MAR near miss alerts for each unit were collected for the 4 weeks pre-implementation, during the 12-week implementation at 6-week intervals, and for the 4 weeks post-implementation.

Absenteeism of nursing staff was measured as the number of scheduled shifts missed or not worked during the project period. Absenteeism is recorded biweekly by the nurse manager through an automated time and attendance software program, Kronos®. Nurse managers or their designee(s) are responsible for manually entering any time not accounted for due to a failure or inability to clock in or out by nursing staff. Absenteeism data can then be retrieved from the Kronos® system as an aggregate number for the unit on a biweekly basis. Absenteeism was collected for a 4-week period (i.e., 2 pay periods) pre-implementation, during the 12-week implementation, and for 4 weeks post-implementation.

Overtime of nursing staff was measured as the number of minutes worked over a scheduled 12-hour shift. The number of minutes is recorded through an automated time and attendance software program, Kronos®. Nursing staff clock in and out for each shift worked. A 30-minute meal break is automatically deducted by the software program unless the staff member clocks out "no lunch". Overtime was collected from Kronos® as an aggregate number of the unit biweekly for 4 weeks (2 pay periods) pre-implementation, during the 12-week implementation, and for 4 weeks post-implementation.

Procedures

IRB approval for the study was obtained through the University of North Carolina at Chapel Hill and from the project site's Nursing Research Council (NRC). Upon receiving the necessary approvals, an introduction to the survey and instructions on how to access the survey were provided via flyers in the unit and an email to current nursing staff through the unit nurse manager. Two reminder emails were sent via the unit nurse manager (on Day 7 and on Day 12) to thank participants who had responded and remind those who were still interested in participating that the survey would be accessible for the remaining time. Prospective participants were informed that participation in the survey was voluntary and to simply disregard invitations and information if they did not wish to participate. Prospective participants were also informed that if, at any time after launching the survey they wished to end the survey, they could close their web browser to end the survey.

The survey tool was formatted and administered as a web-based survey using the Qualtrics software and housed on a Qualtrics server where anonymous responses were collected. Qualtrics is a software program that enables users to create web based surveys and conduct statistical analysis. Participants were instructed to read the informed consent information

provided on the first page of the survey and to click on “Agree” at the bottom of the page if they were willing to participate in the survey. After clicking “Agree”, participants launched the survey by clicking “next page” located directly under the “Agree” button. Because participants did not create a login for the survey, they could not partially complete surveys. Thus participants accessed and completed the survey in one ‘sitting’. The online survey took less than 20 minutes to complete.

Upon completion of the online survey, participants were offered the opportunity to enter their name into a drawing for one of forty $5 Freedom Pay cards (10 cards were awarded per nursing unit). Freedom Pay cards can be used to purchase merchandise at any of the restaurants or dining areas within the local area surrounding the project site. Participants were redirected to a separate survey that housed an explanation as to how and when the drawing would take place. If participants were interested in entering their name into the drawing there was a text box provided for them to type their name and unit. Once the survey was closed all names were entered into a drawing by the primary investigator and ten names from each unit were selected at random to receive the incentive.

Upon completion of the intervention, nursing staff were again invited to participate in an anonymous online survey measuring work-related fatigue using the OFER15 scale and sleep quality using the PSQI. The procedures for inviting and distributing the survey followed the pre intervention survey procedures. The survey remained open for 4 weeks following the intervention. Participants were also again offered the opportunity to participate in a drawing.

The primary investigator monitored compliance implementation of the intervention through bi-weekly email communication with the unit nurse manager or designee(s). Also, the primary investigator and the site’s nurse researcher met with the unit nurse manager or

designee(s) at weeks 3 and 9 of the intervention, as a halfway point during each 6-week schedule to assess compliance and identify any barriers to project completion. Furthermore, the primary investigator recorded major events, questions that arose, and suggestions identified by the nurse manager or designee(s).

Human Subjects

All participants were given a clear description of the project, explanation of the purpose of the project, and information regarding the use of data collected. The participants were provided contact information (email and telephone) for questions.

Survey data (demographics, OFER15, and PSQI) were voluntarily submitted via an anonymous, confidential Web link. Participants were not required to log in or submit a password to access the survey. Thus, there was no way to identify individuals who participated in the survey.

There were no costs or expected risks to study participants. Participation or non-participation in no way affected the participants or their employment. Participants were offered an incentive for completing the survey. The incentive was a drawing for forty, $5 Freedom Pay cards (10 - $5 cards per unit). Participants provided their name for the drawing in a separate survey that remained unlinked to the survey responses. The primary investigator was solely responsible for the drawing and shredded the names once completed.

Information gathered through Kronos® (absenteeism and overtime) and EPIC (near miss alerts) were collected and reported in groups and could not be linked to individuals. All data files were stored on a password protected computer kept in the possession of the primary investigator and were destroyed upon completion of this project. The faculty advisor of the

project also had access to the data, and will maintain data on a password protected computer in her School of Nursing office for a minimum of 5 years, as required by the university.

Monitoring

A project timeline was developed and shared with project committee members (the project committee chair, site's nurse researcher, and school of nursing faculty member), the NPC chair, the NPC nursing director liaison, the NRC chair, and the NRC director liaison as a means to monitor progress. The project timeline was also shared with the nurse managers and/or leadership designee(s) from the four units on which the intervention took place after they were identified. Face-to-face meetings were held with the project committee's chair, site's nurse researcher, the NPC chair, and NPC nursing director liaison at 3 points in times: after preliminary fatigue prevalence data had been collected and units had been identified as potential intervention sites; at the intervention mid-point; and once the project was finished. The face-to-face meetings were set to review project progress on the approved project timeline, address identified risks to the completion of this project, and share results from the project.

Resources

Identified stakeholders (Chief Nursing Officer, Associate Chief Nursing Officer, Nursing Practice and Professional Development Director, chair of NPC, NPC nursing director liaison, chair of NRC, and site's nurse researcher) were supportive of the identified project as it aligned with the nursing division's 2014 and 2015 fiscal year goals. The identified project site provided the financial and personnel resources needed to distribute the copyrighted OFER15 instrument and gather preliminary perceived work-related fatigue data to inform the project intervention. The Chief Nursing Officer further expressed willingness to invest resources and personnel needed to implement the project's intervention.

Online survey software provided by the University of North Carolina at Chapel Hill was utilized to house and collect anonymous responses to the surveys used as measurement tools in this project.

CHAPTER 4

RESULTS

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences® (SPSS) version 22 and Excel®. A reliability analysis was performed and reported for the OFER15 subscales and PSQI total score. Descriptive statistics (i.e., frequencies, means, standard deviations, and ranges) were used to analyze demographic information, OFER15 subscales, PSQI total score, MAR near miss alerts, absenteeism, and overtime. Independent-samples t-test and paired-samples t-test were used to compare the means of pre and post OFER15 subscales, PSQI, MAR near miss alerts, absenteeism, and overtime. Significance was set at 0.1 since the project was exploratory and had a small sample size. Bivariate correlations were examined between demographic variables, OFER15 subscales, and PSQI total score. Bivariate correlations were also examined between OFER 15 subscales, PSQI total score, MAR near miss alerts, absenteeism, and overtime.

Responses to the demographic items, OFER15, and PSQI were downloaded through the Qualtrics website into a SPSS file. OFER 15 items 9, 10, 11, 13, and 15 were reversed scored. Each subscale (chronic fatigue [OFER-CF], acute fatigue [OFER-AF], and inter-shift recovery [OFER-IF]) was scored by summing the five corresponding items (OFER-CF 1-5, OFER-AF 6-10, and OFER-IF 11-15), dividing the sum by 30, and then multiplying by 100. This yielded a

score that reflects comparable values between 0-100 for each subscale by which a higher score indicates a greater presence of that attribute.

PSQI items were scored using the PSQI Scoring Database, a Microsoft® Access database that was downloaded with permission from the author (D. Buysse, personal communication, June 4, 2014). Respondent data was entered into the database to automatically calculate the PSQI subscale scores (duration of sleep, sleep disturbance, sleep latency, day dysfunction, sleep efficiency, and overall sleep quality) and total PSQI score. This yielded comparable values between 0-3 for each subscale and 0-21 for the total PSQI score by which a higher score indicates worse sleep quality. Subscale scores and total PSQI score was transferred back into SPSS with the corresponding respondent for analysis.

Kronos®, an automated software program, collected clock-in time, clock-out time, and attendance, which were downloaded as an Excel file. Data extracted for each employee were coded as RN or NAP and the dates of each time clock event were coded into corresponding pay period for analysis and subsequently phases of implementation. Absenteeism data were summed for intervention units (randomly coded as units 1 through 4), for each 2-week pay period, and then for the RN and NAP groups on each unit. Overtime was also summed and averaged in number of minutes over a 12-hour shift for the four intervention units, and then for the RNs and NAPs working on the units.

Results

Demographics

A total of 62 respondents accessed the online survey and provided data on demographics, work-related fatigue, inter-shift recovery, and sleep quality data pre-implementation, and a total of 64 provided data post-implementation. This was a 28.2% response rate pre-implementation

and a 29% response rate post-implementation (N = 220). A total of 23 respondents (10.5%) provided a unique code by which the pre and post implementation surveys could be paired for analysis. Although the surveys were distributed to both registered nurses (RNs) and nursing assistive personnel (NAP), RN respondents were in the majority (69.4% pre-implementation, 56.3% post-implementation). The majority of RN respondents indicated holding a position as a Clinical Nurse (CN) I or II (72.8% pre, 80.6% post) on the site's clinical ladder. Table 2 gives the frequency and percentage of pre-post implementation respondents per unit and position type

Table 2

Number and Percentage of Respondents by Unit and Position Type

	Pre-implementation		Post-implementation	
Respondents	*n*	Percent	*n*	Percent
Unit 1	16	25.8	27	43.5
Unit 2	16	24.2	16	25.8
Unit 3	15	25.8	12	19.4
Unit 4	15	24.2	7	11.3
Registered Nurse	43	69.4	36	56.3
Nursing Assistant I or II	6	9.7	11	17.2
Health Unit Coordinator	4	6.5	6	9.4
Clinical Support Technician I or II	9	14.5	11	17.2
Total	62		64	

Respondents were asked to indicate their age, number of years worked in their current role, and highest level of academic achievement. The mean age of RN respondents was 38.6

years of age (SD = 12.7), with a range of 23 to 64 years and the mean age of NAP respondents was 32.8 years of age (SD = 8.7), with a range of 21 to 49 years. The mean number of years RN respondents reported practicing was 11.2 years, with a range from 0.5 – 37 years. The majority of nursing assistive personnel reported practicing in their role for 5 years or less (77.3%), followed by 13.6% reporting 6 to 10 years, 4.5% reporting 11 to 20 years, and 4.5% reporting more than 20 years.

The RN respondents reported their highest level of academic achievement in nursing as a Baccalaureate in Nursing (BS) (66.3%); Associate Degree in Nursing (28.8%), or Master of Science in Nursing (5%). Finally, 26.6% of respondents reported being currently enrolled as a student, and of those, 18.8% was enrolled in full-time, and 7.8% was enrolled in part-time study.

Shifts Worked

The majority of respondents reported routinely working a 12-hour shift (96.8%). Respondents also reported routinely working consecutive shifts (89%). They typically worked three shifts a week (74.6%), though a few worked four shifts a week (17.5%). Almost half of the respondents reported that they were typically scheduled to work day shift (45%); some reported working mostly night shift (20.6%), and others reported that they rotated shifts (30.2%), or did not have a typically scheduled shift (4%).

No respondents reported working in a second job, outside the project organization in the pre-implementation phase, and only two respondents reported working a second job in the post-implementation phase.

Nursing Outcome

To determine how the implementation of fatigue management strategies affected nursing outcomes perceived work-related fatigue and sleep quality, the OFER15 subscales were

examined for reliability. A Cronbach's alpha coefficient for the OFER15 chronic fatigue subscale was 0.87, for the OFER15 acute fatigue subscale it was 0.74, and for the OFER15 inter-shift recovery subscale it was 0.72. These values satisfy the requirements for adequate internal reliability. The instrument's authors reported an internal Cronbach's alpha coefficient of 0.86 for the OFER15 chronic subscale, 0.84 for the OFER15 acute subscale, and 0.84 for the OFER15 inter-shift reliability subscale.

OFER15 subscale scores were first examined among individuals who completed both the pre-and post-implementation surveys and supplied a generic code by which to link the surveys. Although there was a slight decrease in chronic and acute fatigue mean scores, no significant difference was found. Next, OFER15 subscale scores were examined for the pre-and post-implementation data in the aggregate. Prior to the implementation of the fatigue management strategies, the mean chronic fatigue score was 45.5 (SD=21.3), the acute fatigue score was 63.1 (SD=23.4), and the inter-shift recovery score was 51.9 (SD=22.2). Post-implementation, the mean scores were 44.1 (SD=26.7) for chronic fatigue, 61.1 (SD=22.1) for acute fatigue, and 50.8 (SD=20.9) for inter-shift recovery. No significant changes in OFER15 subscale scores from pre- to post-implementation scores were found using an independent samples t-test.

OFER15 pre-and post-implementation subscale scores were further examined by position type and unit. A significant ($p = 0.03$) decrease in acute fatigue was found for nursing assistive personnel (NAP) with a mean score decrease from 68.77 (SD = 20.7) to 54.4 (SD = 21.6), but there was no other significant difference by position type. When examining OFER15 subscale scores by unit, a significant ($p = 0.08$) increase in inter-shift recovery and a near significant ($p = 0.11$) decrease in chronic fatigue were noted in unit 4 nursing staff with a mean increase from 44.89 (SD = 20.77) to 61.9 (SD = 19.4). There were no moderate or strong correlations found

between the OFER15 subscale scores and other demographics (age, type of position, number of years in role, type of education, additional employment, typical work schedule, and status as student). See Appendix D for OFER15 results for paired individuals, responses in the aggregate, RN respondents, NAP respondents, units 1 – 4, and bivariate correlations.

The total PSQI score was examined for reliability. A Cronbach's alpha coefficient for the total PSQI score was 0.74. This represented good internal reliability. The instrument's authors reported a Cronbach's alpha coefficient of 0.83 for the total PSQI score.

The total PSQI score was first examined using a paired t-test for individuals who had completed both the pre-and post-implementation surveys and supplied a generic code by which to link the surveys. No significant difference was found ($p = 0.59$) in the total PSQI score. Next, the total PSQI score was examined for the pre-and post-implementation data in the aggregate. Prior to the implementation of fatigue management strategies, the total PSQI score was 7.3 (SD=3.41), which is associated with poor sleep quality (PSQI >5). The post-implementation total PSQI score had decreased to 6.4 (SD=3.3) but remained associated with poor sleep quality. Although there was a decrease in the total PSQI score, no significant change was found using an independent samples t-test ($p = 0.15$). Then, the total PSQI score was examined pre-and post-implementation by position type and unit. The score significantly decreased ($p = 0.02$) for NAP respondents from a mean of 8.7 (SD = 2.96) to a mean of 6.2 (SD = 3.46). There was also a significant decrease ($p = 0.09$) in nursing staff on unit 4 from a mean of 8.4 (SD = 3.7) to a mean of 4.5 (SD = 4). There were no moderate or strong correlations found between the total PSQI score and demographics (age, type of position, number of years in role, type of education, secondary employment, typical work schedule, and status as student). See Appendix E for PSQI

results for paired individuals, responses in the aggregate, RN respondents, NAP respondents, units 1 – 4, and bivariate correlations.

Finally, there were moderate or strong correlations found between the OFER15 subscales and the total PSQI score. The OFER15 inter-shift recovery subscale had a significantly strong negative relationship with the OFER15 chronic fatigue subscale (-0.65), the OFER15 acute fatigue subscale (-0.67), and total PSQI score (-0.5). The OFER15 chronic fatigue subscale showed a significantly strong positive relationship with the OFER15 acute fatigue subscale score (0.6) and a moderate positive relationship with the total PSQI score (0.39). The OFER15 acute fatigue subscale was significantly positively related to the total PSQI score (0.47). See Appendix F for bivariate correlations between the OFER15 subscales and the total PSQI score.

Patient Outcome

To determine how the implementation of fatigue management strategies affected patient outcomes unit-level medication administration record [MAR] near miss alerts. MAR near miss alerts were downloaded at four points for each of the four participating units and averaged per week. No significant change was found in the unit specific or total MAR near miss alerts between the pre-implementation, implementation, and post-implementation phases. See Appendix G for unit specific and total MAR near miss alerts reported pre-implementation, during the 12-week implementation at 6 week intervals, and post-implementation.

Unit Outcome

Finally, to determine how the implementation of fatigue management strategies affected unit performance absenteeism and overtime. Absenteeism and overtime were retrieved from Kronos®, an automated software program, and summed for each of the four intervention units for each of the 2-week pay periods by position (RN and NAP). Overtime was further averaged in

number of minutes over a 12-hour scheduled shift for the four units and by 2-week pay period. No significant change was found in RN or NAP absences, analyzed by 2-week pay period in the aggregate and by unit. Additionally, there was no significant decrease in the number of minutes past a 12-hour scheduled shift for either RNs or NAP. RNs averaged 18.5 (SD = 72) minutes past their 12-hour shift, and NAP averaged 20.3 (SD = 86.8) minutes past their 12-hour shift. See Appendix H for absences in total and by unit for each position (RN and NAP) and for the total and average minutes that RNs and NAP worked past a 12-hour scheduled shift, reported at 2-week intervals pre-implementation, during the implementation, and post-implementation.

CHAPTER 5

DISCUSSION

This project evaluated the affects of fatigue management strategies (i.e., the intervention) implemented on four adult medical or surgical units at one large academic medical center. The project was completed in collaboration with the project site (NPC chair and NPC director liaison) and project committee members. Measures used in evaluating the intervention included the OFER15 scale, the total PSQI score, the number of MAR near miss alerts, absenteeism, and overtime. The fatigue management strategies – duty free breaks, limiting consecutive hours worked, and limiting consecutive shifts - were evaluated for their potential implementation throughout the nursing division, with respect to feasibility of implementation and change in objective measures of nurse fatigue.

The major project findings included a significant decrease in nursing assistive personnel respondents' reported acute fatigue and an increase in sleep quality. Nursing staff on one of the four units also reported a significant increase in inter-shift recovery and improved sleep quality. Finally, nursing staff were found to have a poor sleep quality regardless of demographics (i.e., age, position, shift type).

Moving forward, the NPC in the project site plans to formulate a recommendation to the project site's chief nursing officer outlining the fatigue management strategies used in this project, their feasibility of implementation, and the potential to positively affect one or more of

the objective measures (e.g. decrease in perceived work-related fatigue, increase in sleep quality, decrease in MAR near miss alerts, decrease in absences, and decrease in overtime).

Discussion

The findings from this project are consistent with the findings from previous research that describe nursing staff working predominately 12-hour consecutive shifts and report a poor sleep quality. The findings indicated no correlation between age, position (RN or NAP), number of years in role, academic achievement, shift type, number of shifts worked per week, or status as a student with reported work-related fatigue and sleep quality. No significant decrease was found in work-related fatigue nor was an increase in sleep quality for the participants in aggregate found after the implementation of fatigue management strategies (i.e. duty-free break, limiting consecutive work hours, and limiting consecutive work shifts).

However, there were significant findings with subsets. The nursing assistive personnel reported a significant decrease in acute fatigue and an increase in sleep quality following the implementation of fatigue management strategies. Additionally, staff on one of the four intervention units reported a significant increase in inter-shift recovery and an improvement in sleep quality following the implementation of fatigue management strategies. Although not significant, a decrease in the mean chronic and acute fatigue subscale scores and total PSQI score was found when comparing paired respondents and respondents in the aggregate. A longer intervention period may have led to more significant changes in the OFER15 subscale and total PSQI scores.

In comparison to the research studies reviewed, this project's findings were similar in nature (Eldevik, Flo, Pallesen, & Bjorvatn, 2013; Geiger-Brown et al., 2012; Rogers, Hwang, Scott, Alken, & Dinges, 2004; Scott, Rogers, Hwang, & Zhang, 2006). All of the prior studies

found that a majority of nurses work consecutive 12-hour shifts and are unable to fully recover between shifts due to inadequate sleep. In direct comparison, this project identified nursing staff most often worked a 12-hour shift and the majority reported working consecutive shifts. Furthermore, nursing staff reported poor sleep quality. However, in comparison to Winwood, Winefield, and Lushington (2006) this project did not find a strong or moderate correlation between reported chronic fatigue and working consecutive shifts or rotating shifts.

When compared to research on the affects of fatigue on performance, this project's findings were inconsistent (Rogers, Hwang, Scott, Aiken, & Dignes, 2004; Scott, Rogers, Hwang, & Zhang, 2006). The literature reviewed found that errors increased with the number of hours a nurse worked in a shift exceeded 12.5 hours or when the hours in a week exceeded 40. The results of this project revealed no change in MAR near miss alerts after implementing a limitation on consecutive hours and consecutive shifts a nurse could work. However, the research studies reviewed did use a differing methodology (participant logs) to collect errors or near errors than this project. This project used an automated reporting methodology capturing only errors or near errors that occur during medication administration. This difference in reporting methodology may account for the difference in findings.

Finally, in comparison to the research reviewed on fatigue management strategies, this project did not find a similar decrease in errors or near miss errors with the implementation of fatigue management strategies (Rogers, Hwang, & Scott, 2004; Scott, Hofmeister, Rogness, & Rogers, 2010; Warren & Tart, 2008). However, similarities in implementation that had been reported anecdotally in the literature were noted. Acceptance of work-related fatigue, its impact on performance, and the positive effects of fatigue management strategies among nursing staff was essential for staff buy-in. Additionally, organizational and formal leadership (nurse manager

and/or designee) was necessary for implementation, but informal leadership among charge nurses, well regarded nursing staff, or nursing staff with tenure was crucial to the success of this implementation. Furthermore, the unwillingness of nursing staff to relinquish patient care responsibilities in order to take a duty-free break was a barrier that had to be overcome for the full implementation of this project's intervention. All anecdotal findings during implementation further highlight the need for a partnership between the employee and employer during the development and implementation of fatigue management strategies.

Finally, this project adds a new dimension to the literature because it was inclusive of all nursing staff (RN and ANP) to more broadly address fatigue management strategies within the unit-level staff. The literature reviewed included only registered nurses which excludes a large part of the nursing staff, assistive nursing personnel.

Limitations

There are certain limitations of this project that must be considered. The project's small sample size within a single organization prevents the generalization beyond the project's setting. The overall low survey response rate (28.2, 29%) and rate at which individuals completed both the pre and post implementation surveys and linked their surveys via a generic code (10.5%) may have influenced the findings and limits conclusions that can be drawn. Evidence suggests a 40% response rate is needed for reliability and accuracy when using unit-specific scales or instruments within a hospital setting (Kramer, Schmalenberg, Brewer, Verran, and Keller-Unger, 2009). Future projects should focus on increasing the generalization of findings by increasing the sample size and involving more than one organization. Consideration of survey timing in order to prevent the respondents from survey fatigue and offering small incentives to each

individual for survey completion rather than a drawing for several larger incentives may increase the response rate in future projects.

Furthermore, the self report measures of work-related fatigue and sleep quality are absent of any physiologic monitoring. Time constraints and availability of resources to physiologically measure work-related fatigue and sleep quality influenced the methodology of this project and thus led to the aforementioned limitations.

Finally, the OFER15 scale may have not been sensitive to measuring the affects of the fatigue management strategies implemented in this project's intervention. The OFER15 scale items are written to evaluate the respondent's fatigue at work and at home, but this project did not evaluate other sources of fatigue such as perceived or actual work load, family responsibilities, or work commute that the intervention could not affect.

Implications

Despite the limitations, this project provides valuable information that can be used to guide future fatigue management strategy implementation, future research, and the development of educational programs for nurses to increase their awareness of fatigue and its consequences. This project had two implications for the units and organization where it was conducted. First, this project heightened awareness among all nursing staff members on the nursing units examined by encouraging participation in the organization wide OFER15 survey and discussing the project's objective in multiple forums during each of the project's phases. This heighted awareness may lead to crucial conversations or the implementation of other work-related fatigue management strategies on the respective units or overall healthcare organization. Second, this project will inform the NPC's fatigue management recommendation to senior nursing leadership. The NPC is working to make a recommendation on practical evidence-based fatigue

management strategies that can be adopted organizationally as part of the nursing division's 2015 fiscal year goals.

Dissemination

The dissemination of project findings will be accomplished through a public presentation at the University of North at Chapel Hill's School of Nursing, a presentation to the project site's NPC and other organizational leaders, and the submission of a manuscript to a peer reviewed nursing administration journal for publication. A public presentation at the University of North Carolina at Chapel Hill's School of Nursing was required for final approval of this project and served to inform attendees of the impact of nurse fatigue on patient care delivery and the importance of fatigue management strategies in reducing fatigue in nursing staff. The project site's NPC maintains an ongoing interest in decreasing nursing staff work-related fatigue and has been charged with identifying evidence-based fatigue management measures that may be recommended for organizational adoption. Finally, due to the rising attention paid by health care organizations to nurse work-related fatigue and initiatives designed to reduce nurse fatigue the findings of this project will be submitted for publication in a nursing administration journal, as well as published through abstracts, posters, and podium presentations at professional meetings.

Summary/Conclusion

Nursing staff, registered nurses and nursing assistive personnel, deliver a significant portion of the care provided to patients and are in a position to influence patient safety and quality of care through their delivery and decisions made at the bedside. Patients depend on nursing staff cognition and their ability to intervene on their behalf when necessary. Unfortunately nursing staff are subjected routinely to long work shifts, working past their scheduled shift end time, and rotating shifts which leads to sleep deprivation and fatigue. Sleep

deprivation and fatigue can lead to a decrease in productivity and an increased risk of error or near miss error.

The findings of this project described nursing staff working predominately 12-hour consecutive shifts and reported a poor sleep quality. Although there were no significant findings with the aggregate sample after the implementation of fatigue management strategies, there were significant changes in acute fatigue, inter-shift recovery, and sleep quality when analyzing the data in subsets. Future research evaluating the implementation of similar and other fatigue management strategies is needed to inform the literature. Finally, the development of educational programs for nursing staff to increase their awareness of fatigue and its consequences is necessary for them to partner with their employer to identify practical strategies to decrease work-related fatigue.

Appendix A

Description of Intervention Units and Target Sample Personnel

Unit	Level of Patient Care	# of Beds	# Unit FTEs	Full/ Part Time RNs	Per Diem RNs	Full/ Part Time NAP	Per Diem NAP
1	Adult Surgical Acute Care	35	36.78 RN 21.43 NAP	38	2	20	13
2	Adult Surgical Acute Care	22	24.08 RN 9.45 NAP	25	5	10	6
3	Adult Surgical Acute Care	15	17.8 RN 10.35 NAP	21	5	11	3
4	Adult Medical Acute Care	28	27.33 RN 12.22 NAP	34	7	12	8

Note. FTE = full time equivalent

Appendix B

Work-Related Fatigue and Sleep Quality Survey

Informed Consent You are being invited to participate in a survey examining fatigue and sleepiness. Please read the information below before agreeing to participate. The purpose of this survey is to assess your work-related acute and chronic fatigue, your recovery between work shifts, and your overall sleep quality. Your participation is voluntary. Your answers will be kept confidential. There is no user ID or password to access this survey therefore your answers cannot be directly linked to you. We do not anticipate any risks to you for participating in this study. Any information you provide will be combined with the responses provided by others, and reported only in groups. If you decide not to take part it will not affect your current or future employment. You may stop your participation at any time by closing your internet browser. You will be asked to answer about 50 questions that include multiple choice and short answer. The questionnaire will take approximately 20 minutes to complete. You will be given the opportunity to enter a drawing for a $5 Freedom Pay card at the close of this survey. There will be 10 names drawn from your unit that will receive this incentive. At the end of this survey you will be directed to a separate link that will ask for you to submit your name to enter the drawing. The two links are in no way connected. I, along with Dr. Cheryl Smith-Miller (the UNCH nurse researcher), will conduct the drawing and then shred all names once the winners have been identified. Entering the drawing is also voluntary and you may choose to complete the survey without entering. If you have questions regarding this survey, you may contact the principal investigator Christa Seaman RN, MSN, CCRN at cseaman@unch.unc.edu or 919-966-8411. Research Team members include Christa Seaman, Dr. Cheryl Jones, and Dr. Cheryl Smith-Miller Thank you for your time.

I have read and understood the above consent form and desire of my own free will to participate in this survey.

- ❍ Yes
- ❍ No

If No Is Selected, Then Skip To End of Survey

Part I - Demographics The following questions are about you, your position, and your education. Please answer to the best of your ability - your responses are anonymous.

What is your age?

Please select the option that best describes your current position:

- ❍ Registered Nurse
- ❍ Nursing Assistant I or II
- ❍ CST I or II
- ❍ Health Unit Coordinator

Skip Logic >> If Registered Nurse selected
Please indicate your current position as an RN at UNCH

- ❍ Clinical Nurse (CN) I or II
- ❍ CN III or CNIV
- ❍ Other

In what year did you receive your first nursing license?

How many years have you NOT worked as a nurse since receiving your license?

Please indicate your highest level of academic achievement in nursing:

- ❍ Associate Degree - Nursing (1)
- ❍ Bachelor of Science - Nursing (2)
- ❍ Master of Nursing (3)
- ❍ PhD/Doctorate - Nursing (4)

Skip Logic >> If Nursing Assistant I or II, Health Unit Coordinator, or CST I or II is selected
How many years have you worked in your current role?

- ❍ 0-5 years (1)
- ❍ 6-10 years (2)
- ❍ 11-20 years (3)
- ❍ more than 20 years (4)

Part I - Continued The following questions are related to your unit and work schedule. Please answer to the best of your ability - your responses are anonymous.

On which unit do you work?

How many shifts do you typically work in a week?

How many hours are you typically scheduled per shift?

- ❍ 12 hours
- ❍ 8 hours
- ❍ 4 hours

Skip Logic>> If 12 hours is selected

What is your typically scheduled shift?

- ❍ Days (0700 - 1900; 1100 - 2300)
- ❍ Nights (1900 - 0700; 2300 - 1100)
- ❍ Rotating (3)
- ❍ I don't have a typically scheduled shift.

Skip Logic>> If 8 hours or 4 hours is selected

Q18 When is your shift typically scheduled?

- ❍ Days (generally between the hours of 0700 - 1500) (1)
- ❍ Evenings (generally between the hours of 1500 - 2300) (2)
- ❍ Nights (generally between the hours of 2300 - 0700) (3)
- ❍ Rotating (4)
- ❍ I don't have a typically scheduled shift (5)

Are you typically scheduled to work more than 1 shift in a row?

- ❍ Yes
- ❍ No

Skip Logic>> If Yes is selected

How many shifts do you typically work in a row?

- ❍ Fewer than 3 days/nights
- ❍ 3 days/nights
- ❍ 4 days/nights
- ❍ More than 4 days/nights

Does your unit have scheduling guidelines?

- ❍ Yes
- ❍ No
- ❍ I don't know

Skip Logic>> If Yes is selected

Do these guidelines define the maximum number of shifts you are allowed to work in a row?

- ❍ Yes
- ❍ No
- ❍ I don't know

What is the maximum number of shifts you are allowed to work in a row?

Do these guidelines define the number of hours scheduled off between working a night shift and returning to work a day shift?

- ❍ Yes
- ❍ No
- ❍ I don't know

Skip Logic>> If Yes is selected

What is the number of hours scheduled between working a night shift and returning to work a day shift?

How consistent is your schedule?

- ❍ Very consistent with unit scheduling guidelines
- ❍ Somewhat consistent with unit scheduling guidelines
- ❍ Somewhat inconsistent with unit scheduling guidelines
- ❍ Inconsistent with unit scheduling guidelines

In the past month, approximately how many shifts have you stayed over more than 30 minutes after your shift ended?

- ❍ None
- ❍ 1 - 3
- ❍ 3 - 6
- ❍ 6 - 12
- ❍ More than 12
- ❍ Unsure

Do you work at another job in the same or similar position as your position at UNCH? For example, you work as a nurse at UNCH and a nurse at another hospital.

- ❍ Yes
- ❍ No

Skip Logic>> If Yes is selected
On average, how many hours a week do you work at your other job?

Part II - Occupational Fatigue Exhaustion Recovery (OFER15) Scale

Directions: This part of the survey asks about your level of fatigue over the past few months. Rate your level of disagreement or agreement from 0 (strongly disagree) to 6 (strongly agree).

	0	1	2	3	4	5	6
I often feel ‘at the end of my rope’ with my work.	❍	❍	❍	❍	❍	❍	❍
I often dread waking up to another day of my work.	❍	❍	❍	❍	❍	❍	❍
I often wonder how long I can keep going at my work.	❍	❍	❍	❍	❍	❍	❍
I feel that most of the time I’m “living to work”.	❍	❍	❍	❍	❍	❍	❍
Too much is expected of me at work.	❍	❍	❍	❍	❍	❍	❍
After a typical work period I have little energy left.	❍	❍	❍	❍	❍	❍	❍
I usually feel exhausted when I get home from work.	❍	❍	❍	❍	❍	❍	❍
My work drains my energy completely every day.	❍	❍	❍	❍	❍	❍	❍
I usually have lots of energy to give my family or friends.	❍	❍	❍	❍	❍	❍	❍
I usually have plenty of energy left for my hobbies and other activities after I finish work.	❍	❍	❍	❍	❍	❍	❍
I never have enough time between work shifts to recover my energy completely.	❍	❍	❍	❍	❍	❍	❍
Even if I'm tired from one shift, I'm usually refreshed by the start of the next shift.	❍	❍	❍	❍	❍	❍	❍
I rarely recover my strength fully between work shifts.	❍	❍	❍	❍	❍	❍	❍
Recovering from work fatigue between work shifts isn't a problem for me.	❍	❍	❍	❍	❍	❍	❍
I'm often still feeling fatigued from one shift by the time I start a new one.	❍	❍	❍	❍	❍	❍	❍

Part III - Pittsburgh Sleep Quality Index

Directions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month.

During the past month, what time have you usually gone to bed?

During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

During the past month, what time have you usually gotten up?

During the past month, how many hours of actual sleep did you get at night? (this may be different than the number of hours you spent in bed)

Part III - Continued Directions: Check the best response to each of the following questions. During the past month, how often have you had trouble sleeping because you...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Cannot get to sleep within 30 minutes	❍	❍	❍	❍
Wake up in the middle of the night/day or early morning/evening	❍	❍	❍	❍
Have to get up to use the bathroom	❍	❍	❍	❍
Cannot breathe comfortably	❍	❍	❍	❍
Cough or snore loudly	❍	❍	❍	❍
Feel too cold	❍	❍	❍	❍
Feel too hot	❍	❍	❍	❍
Had bad dreams	❍	❍	❍	❍
Have pain	❍	❍	❍	❍
Other: Please describe below	❍	❍	❍	❍

During the past month, how would you rate your sleep quality overall?

❍ Very good
❍ Fairly Good
❍ Fairly Bad
❍ Very Bad

During the past month, how often have you....

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
taken medicine to help you sleep (prescribed or over the counter)	❍	❍	❍	❍
had trouble staying awake while driving, eating meals, or engaging in social activity	❍	❍	❍	❍

During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

- ❍ No problem at all
- ❍ Only a very slight problem
- ❍ Somewhat of a problem
- ❍ A very big problem

Part IV - Self - Generated Identification Code

Directions: This last part will ask you several questions in order to create your own self-generated identification code which will protect your anonymity. Why? Researchers sometimes need to collect information repeatedly from the same volunteers over a period of time in such a way as to satisfy two requirements: (a) each batch of information needs to be connected with the particular person who furnished it, and (b) the information needs to be collected anonymously to protect the privacy of the volunteers. One way to satisfy both requirements is to have each volunteer generate his/her own Identification Code based on information well known to the participant but unknown to the researcher. This is what this page involves. Therefore, please CAREFULLY furnish the following information:

Please select the letter below that represents the First Letter of your MOTHER'S FIRST NAME: (If unknown select Z)

Please select the letter below that represents the First Letter of your FATHER'S FIRST NAME: (If unknown select Z)

How many Older Brothers do you have? (both alive and deceased, step or otherwise)

How many Older Sisters do you have? (both alive and deceased, step or otherwise)

Please select the month in which you were born.

Please select the letter below that represents the First Letter of your MIDDLE NAME: (If you have no middle name select N)

Appendix C

Permission from Author of PSQI

Email received Wednesday, June 04, 2014.
Sent on behalf of Dr. Buysse

Dear Christa,

You have my permission to use the PSQI for your research study. You can find the instrument, scoring instructions, the original article, links to available translations, and other useful information at www.sleep.pitt.edu under the Instruments tab. Please ensure that the PSQI is accurately reproduced in any on-line version (including copyright information). We request that you to cite the 1989 paper in any publications that result.

Note that Question 10 is not used in scoring the PSQI. This question is for informational purposes only, and may be omitted during data collection per requirements of the particular study.

This copyright in this form is owned by the University of Pittsburgh and may be reprinted without charge only for non-commercial research and educational purposes. You may not make changes or modifications of this form without prior written permission from the University of Pittsburgh. If you would like to use this instrument for commercial purposes or for commercially sponsored research, please contact the Office of Technology Management at the University of Pittsburgh at 412-648-2206 for licensing information.

Good luck with your research.

Sincerely,

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Appendix D

Nursing Outcome: OFER15 Results

OFER15 Subscale Means, Standard Deviations, paired t-test, and p-values for Paired Respondents

Subscale		*M*	SD	*t*	*p*
Chronic	Pre	46.52	20.53		
	Post	41.88	29.60	1.39	0.15
Acute	Pre	65.36	21.17		
	Post	61.73	24.28	1.17	0.25
Inter-Shift	Pre	52.89	22.81		
	Post	52.02	21.87	0.46	0.77

Note. Pre and Post-implementation *n* = 23

OFER15 Subscale Means, Standard Deviations, t-test, and p-value in the Aggregate

Subscale		*M*	SD	*t*	*p*
Chronic	Pre	45.48	21.31		
	Post	44.11	26.72	0.31	0.75
Acute	Pre	63.11	23.42		
	Post	61.09	22.07	0.49	0.62
Inter-shift	Pre	51.98	22.23		
	Post	50.79	20.92	0.31	0.76

Note. Pre-implementation *n* = 62; Post-implementation *n* = 64

OFER15 Subscale Median and Percentiles for the Aggregate

		Chronic	Acute	Inter-Shift
Median	Pre	50	61.6	50
	Post	45	63	46.6
Percentiles	(Pre)			
	25	29.2	50	33.3
	50	50	61.6	50
	75	60	80	66.6
Percentiles	(Post)			
	25	20.8	50	36.7
	50	45	63.3	46.7
	75	60	76.7	70

Note. Pre = Pre-implementation. Post = Post-implementation

OFER15 Subscale Means, Standard Deviations, t- test, and p-value for RN Respondents Data

Subscale		*M*	SD	*t*	*p*
Chronic	Pre	44.80	21.14		
	Post	45.46	24.92	-0.13	0.89
Acute	Pre	60.62	24.34		
	Post	66.29	21.28	-1.09	0.28
Inter-shift	Pre	54.88	22.83		
	Post	47.71	21.50	1.42	0.16

Note. Pre-implementation $n = 43$; Post-implementation $n = 36$

OFER15 Subscale Means, Standard Deviations, t-test, and p-value for NAP Respondents

Subscale		Mean	SD	*t*	*p*
Chronic	Pre	47.01	22.19		
	Post	42.38	29.25	0.59	0.56
Acute	Pre	68.77	20.70		
	Post	54.40	21.60	2.28	0.03*
Inter-Shift	Pre	45.43	19.85		
	Post	54.64	19.88	-1.56	0.13

Note. Pre-implementation n = 19; Post-implementation n = 28

*$p < 0.1$

Bivariate Correlation between OFER15 Subscales and Demographics

Demographic	Chronic Pearson Correlation	*p*	Acute Pearson Correlation	*p*	Inter-shift Pearson Correlation	*p*
What is your age?	-0.11	0.28	-0.24	0.01	0.16	0.12
Current position	-0.04	0.63	-0.06	0.45	-0.01	0.84
Position as RN on clinical ladder	-0.10	0.35	-0.26	0.02	0.09	0.39
Years practicing as RN	-0.19	0.08	-0.26	0.01	0.23	0.04
Years in role as NAP	0.01	0.92	-0.05	0.71	0.16	0.29
Highest level of academic achievement in nursing	-0.22	0.04	-0.17	0.12	0.20	0.07
Number of shifts per week	-0.19	0.02	-0.21	0.01	0.16	0.07
Hours scheduled per shift	-0.09	0.30	-0.30	0.68	0.05	0.56
Typically scheduled shift	-0.03	0.66	0.01	0.90	0.08	0.33
Consecutive shifts	-0.11	0.21	0.18	0.03	0.10	0.23
Number of shifts in a row	-0.11	0.22	0.02	0.80	0.10	0.28
Status as a student	-0.13	0.28	0.04	0.71	0.03	0.76

OFER15 Subscale Means, Standard Deviations, t-test, and p-value for Units 1-4

		Pre		Post			
Unit	Subscale	*M*	SD	*M*	SD	*t*	*p*
1	Chronic	50.2	14	51.35	28.93	-0.15	0.86
	Acute	66.25	14.24	65.43	18.02	0.16	0.88
	Inter-shift	49.16	18.47	47.40	16.12	0.33	0.75
2	Chronic	48.75	22.24	49.16	22.23	-0.05	0.96
	Acute	59.58	25.93	61.67	25.29	-0.05	0.82
	Inter-shift	53.75	22.44	46.67	20.07	0.94	0.35
3	Chronic	30.44	20.96	19.72	17.72	1.41	0.17
	Acute	58	26.63	52.5	25.07	0.55	0.59
	Inter-shift	60.22	26.04	62.42	28.25	-0.21	0.84
4	Chronic	52	21.77	37.14	12.39	1.67	0.11
	Acute	68.67	25.66	52.38	22.58	1.44	0.16
	Inter-shift	44.89	20.77	61.9	19.42	-1.82	0.08*

Note. Unit 1 n = 16 pre, 27 post; Unit 2 n = 16 pre and post; Unit 3 n = 15 pre, 12 post; Unit 4 n = 15 pre, 7 post

*$p < 0.1$

Appendix E

Nursing Outcome: PSQI Results

PSQI Global Score Means, Standard Deviations, t-test, and p-value for paired respondents, respondents in the aggregate, RN respondents, NAP respondents, and Unit 1 – 4 respondents

Respondent		*M*	SD	*t*	*p*
Paired	Pre	6.55	3.08		
	Post	6.35	2.96	0.54	0.59
Aggregate	Pre	7.33	3.43		
	Post	6.40	3.27	1.45	0.15
RN	Pre	6.71	3.46		
	Post	6.52	3.19	0.23	0.82
NAP	Pre	8.68	2.96		
	Post	6.24	3.46	2.38	0.02*
Unit 1	Pre	7.81	2.96		
	Post	6.84	3.29	0.91	0.37
Unit 2	Pre	6.93	2.84		
	Post	6.62	2.63	0.31	0.76
Unit 3	Pre	6.27	4.03		
	Post	5.17	2.89	0.79	0.43
Unit 4	Pre	8.36	3.73		
	Post	4.5	4.04	1.79	0.09*

Note. Paired $n = 20$; Aggregate $n = 60$ pre, 50 post; RN $n = 41$ pre, 29 post; NAP $n = 19$ pre, 21 post; Unit 1 $n = 16$ pre, 19 post; Unit 2 $n = 15$ pre, 13 post, Unit 3 $n = 15$ pre, 12 post; Unit 4 $n = 14$ pre, 4 post

*$p < 0.1$

Bivariate Correlation between PSQI Global Score and Demographics

	PSQI	
Demographic	Pearson Correlation	*p*
What is your age?	-0.06	0.56
Current position	0.17	0.06
Position as RN on clinical ladder	0.07	0.56
Years practicing as RN	-0.08	0.50
Years in role as NAP	0.08	0.62
Highest level of academic achievement in nursing	-0.12	0.28
Number of shifts per week	-0.06	0.47
Hours scheduled per shift	-0.03	0.69
Typically scheduled shift	-0.06	0.52
Consecutive shifts	-0.09	0.30
Number of shifts in a row	0.14	0.15
Status as a student	0.07	0.63

Appendix F

Correlations Between Instrument Subscales

Bivariate Correlation between OFER15 Subscales and PSQI Global Score

	Chronic		Acute		Inter-shift		PSQI	
	Pearson Correlation	*p*	Pearson Correlation	*p*	Pearson Correlation	*p*	Pearson Correlation	*p*
Chronic	1		0.6*	0.00	-0.65*	0.00	0.39*	0.00
Acute	0.6*	0.00	1		-0.67*	0.00	0.47*	0.00
Inter-shift	-0.65*	0.00	-0.67*	0.00	1		-0.5*	0.00
PSQI	0.39*	0.00	0.47*	0.00	-0.5*	0.00	1	

*$p < 0.001$

Appendix G

Patient Outcome Results

MAR Near Miss Alerts reported per 10,000 Administrations

	Pre-implementation		Implementation		Implementation		Post-implementation	
Unit	Total	Average per week	Total	Average per week	Total	Average per week	Total	Average per week
1	342.7	85.7	342.3	57.1	436.5	72.8	376.1	94
2	370	92.5	375	62.5	409.1	68.1	394.6	98.7
3	382.7	95.7	368.2	61.4	375	62.5	335.2	83.8
4	391.5	97.9	440.9	73.3	485.6	80.9	419.5	104.9
Total	1486.9	371.7	1526.4	254.4	1706.2	284.4	1525.4	381.4

Appendix H

Unit Outcome Results

RN and NAP Absences

		Pre			Implementation					Post	
Unit	Position	1	2	3	4	5	6	7	8	9	10
1	RN	8	2	9	3	8	3	0	2	1	12
	NAP	8	2	6	7	5	6	5	5	11	14
2	RN	5	4	10	4	14	5	8	8	4	11
	NAP	0	1	4	0	2	3	2	1	0	4
3	RN	2	1	2	1	2	1	3	4	4	3
	NAP	1	0	0	6	5	1	4	7	4	1
4	RN	1	4	8	8	16	5	9	3	4	2
	NAP	14	9	5	3	5	2	2	3	2	6
Total		39	23	44	32	57	26	33	33	30	53

RN and NAP Absences Mean, SD, Minimum, and Maximum

Unit	Position	*M*	SD	Minimum	Maximum
1	RN	4.8	4.1	0	12
	NAP	6.9	3.4	2	14
2	RN	7.3	3.5	4	14
	NAP	1.7	1.6	0	4
3	RN	2.3	1.2	1	4
	NAP	2.9	2.6	0	7
4	RN	6	4.4	1	16
	NAP	5.1	3.8	2	14
Total	RN	5.1	3.9	0	16
	NAP	4.2	3.5	0	14

Overtime (Minutes >12 hour Scheduled Shift)

	RN			NAP		
Phase	Minutes > 12 hours	*M*	SD	Minutes > 12 hours	*M*	SD
Pre	2402	12.4	5	570	5	2.3
	6575	37.5	18	6669	71	23.1
Implementation	2926	14.6	5.8	636	6	2.6
	2787	14.4	3	608	6.2	2.9
	2788	13.7	5	498	4	1
	2655	13	5.9	555	5	2.5
	3075	15	5.9	627	6.1	4.7
	2635	13	5	473	3.6	1.7
Post	35094	17	5.9	420	4	1
	1206	16.4	9.7	335	10.7	5.7
Total	6214	16.4	9.7	1139	12.1	21.2

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