

NURSES' WORK SCHEDULES, QUALITY OF CARE, AND THE HEALTH OF THE NURSE WORKFORCE REMAIN SIGNIFICANT ISSUES

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Published 2019

Executive Summary

Despite the increased attention to the relationship between fatigue, nurse work schedules, and patient safety over the past 15-20 years, fatigue remains pervasive among hospital staff nurses. Although often dismissed and/or considered “part of the job,” research has demonstrated that fatigue adversely affects cognitive and psychomotor performance, and leads to a greater risk of making an error. In fact, the deleterious effects of fatigue and partial sleep deprivation have been shown to be equivalent to those associated with alcohol consumption.

Current scheduling practices e.g., extended shifts (12 hours or longer), although preferred by most nurses and nurse-managers, favor the development of fatigue. Working longer than scheduled is the norm rather than the exception for hospital staff nurses, and few nurses obtain the seven to eight hours sleep recommended by the American Academy of Sleep Medicine due to the limited number of hours off between shifts. On call requirements, once confined to operating and PACU nurses have spread to many other areas of nursing, also contribute to the development of fatigue.

The long hours worked by nurses have a significant impact on quality of care and the health of the nursing workforce. Extended shifts have been associated with greater risks of errors, higher rates of missed care, higher patient mortality rates and decreased patient satisfaction.

Nurses have one of the highest nonfatal injury rates of all occupations, which may be the consequence of long, cumulative work shifts. Burnout is more common when nurses work 12 hour shifts and injury rates increase by 37%. Needlesticks are common when nurses work longer than scheduled and working more than 40 hours/week is associated with a greater risk of developing obesity, diabetes, heart disease and even an increased risk for unhealthy alcohol consumption.

Night shift work also increases a nurse's risk for developing altered glucose metabolism and diabetes, obesity and being injured on the job. Studies have also shown that nurses who work at night obtain less sleep, experience both more excessive sleepiness and insomnia than nurses who work during the day.

Only a small number of night shift nurses remain on a night shift schedule on their days off, while others switch halfway between nights and days rather than completely switching to day shift on their days off. The majority of night shift nurses, however, revert to a normal day-wake schedule on their days off, creating an internal desynchronization that has been compared to the jet lag experienced by flying back and forth between Tokyo and San Francisco every few days. Instead of depriving themselves of sleep to make the switch between night and day shifts, nurses should identify a consistent 4-hour period when they sleep each day (anchor sleep), to anchor the circadian sleep wake cycle and reduce sleep disturbances.

On an institutional level, appropriate scheduling practices can minimize staff nurse fatigue. The number and duration of consecutive shifts, rest breaks between and during shifts, and expectations regarding on-call work need to be considered when designing work schedules for nurses. Given the high likelihood of work-related fatigue accumulating when nurses work 12-hour shifts, attention should be paid to providing adequate time off between blocks of shifts. At least two consecutive days off should be scheduled for those working traditional 8-hour day shifts, with more consecutive days off required for recovery when working extended shifts or at night. Managers of units where nurses are expected to work on-call should ensure that nurses have at least 6-8 hours off-duty before any on-call period, and create systems to relieve nurses who have worked during their on-call hours, and are scheduled to work their regular shift following the on-call period. Other strategies to minimize staff nurse fatigue and improve patient safety include ensuring that nurses have duty-free breaks by providing adequate staffing, encourage napping during work breaks and discouraging a “supernurse” unit culture.

On an individual level, nurses can minimize fatigue and improve patient safety by obtaining sufficient sleep before and between scheduled work shifts, considering the impact of multiple jobs have on their level of fatigue and ability to practice safely, and using fatigue countermeasures such as caffeine, napping, and breaks to increase their alertness.

None of these strategies to decrease nurse fatigue and improve patient safety are new. In fact, they are quite similar to the strategies recommended by numerous professional organizations over the past decade.

Fatigue is pervasive among hospital staff nurses, with up to 92% reporting that they experience fatigue some times, and 71% reporting that they experience fatigue often or very often¹. Although significantly more nurses report acute fatigue (65%), than chronic fatigue (50%), the moderate level of chronic fatigue reported among nurses is of concern, particularly since higher levels of fatigue are often associated with performance decrements².

Goal

This paper is designed to update and expand upon the issues regarding nurse work schedules, fatigue and quality of care described by Ellis in 2008³. Evidence from nursing and related areas will be cited to describe current nurse work schedules, the effects of fatigue on patient safety, and the effects of shiftwork on the patient safety and the health of the nurse workforce. In addition, specific recommendations regarding various stakeholders' actions to improve patient safety, quality of care and the health of the nurse workforce will be discussed.

1 Raftopoulos V, Charalambou, A., Talias, M. The factors associated with the burnout syndrome and fatigue in Cypriot nurses: A census report. BMC Public Health. 2012;12:457. doi: 10.1186/1471-2458-12-457.

2 Barker LM, Nussbaum, M.A. Fatigue, performance and the work environment: A survey of registered nurses. Journal of Advanced Nursing. 2011;67(6):1370-82.

3 Ellis JR. Quality of Care, Nurses' Work Schedules and Fatigue: A White Paper. Seattle, WA: Washington State Nurses Association; 2008.

Patient Safety Remains a National Issue

One of the earliest reports on patient safety, estimated that 44,000-98,000 people in the United States die each year due to medical error⁴. Other studies however, have suggested that the Institute of Medicine estimate in 1999 was too low, with the number of annual preventable deaths ranging between 210,000 to over 400,000 deaths per year^{5,6,7,8}. In fact, a recent study identified medical error as the third leading cause of death in the United States, ranking behind only heart disease and cancer⁹. Fortunately, only a small percentage of medical errors are lethal (7.4%), with most patients (56.3%) experiencing no or minor disability¹⁰.

Although the phrases “medical error” and “adverse events” are sometimes used interchangeably, they do not refer to the same thing. The term medical error, refers to the incorrect actions or plans for patient care that may or may not cause harm, whereas the term adverse event, refers to actual patient injury due to health care management, rather than by the patient’s underlying disease^{11,12}. Although the majority of both errors and adverse events are considered preventable⁸⁻¹⁰, this paper will focus solely on errors.

Since errors are often the end result of systematic problems rather than the failure of individual providers^{10, 13}, various strategies have been developed to measure and improve patient safety. For example, the “1000 Lives Campaign” focused on developing rapid response teams, improving the care of patients with acute myocardial infarction, as well as preventing adverse drug reactions, surgical site infections, central line infections and ventilator associated pneumonias¹⁴. The goals of a second campaign, “Protecting 5 Million Lives from Harm” included preventing harm from high-alert medications, reducing surgical complications, preventing pressure ulcers, reducing methicillin-resistant staphylococcus aureus (MRSA) infections, delivering evidenced-based care

for congestive heart failure, and getting buy in from hospital boards for these goals¹⁵. Annual National Patient Safety Goals and Sentinel Event Alerts are published and distributed by the Joint Commission on a regular basis to hospitals and other healthcare organizations. Finally, the Leapfrog Group began publishing twice yearly Hospital Safety Grades in 2012 ranking hospitals on 30 different measures of hospital safety, including nurse staffing and nurse communication. In 2018, 30% of the hospitals evaluated received a grade of A, 28% received B grades, 35% received C grades, 6% received D grades and 1% received F grade¹⁶.

Relationship of Fatigue to Errors

Fatigue, which results from continuous physical or mental activity, is characterized by a diminished capacity to do work, accompanied by a subjective feeling of tiredness. Fatigue may be the result of inadequate rest, sleep loss, or from working non-standard work schedules e.g., working at night.

Effects of Fatigue on Performance

Fatigue adversely affects both cognitive and psychomotor performance. According to a 2011 Joint Commission Sentinel Event Alert¹⁷, fatigue adversely affects attention, motivation, problem solving, memory, communication, information processing and judgement, reaction time, and mood, leading to a greater risk of medical errors. The Canadian Centre for Occupational Health and Safety also reports that fatigue is associated with a reduced ability to do complex planning, reduced ability to handle stress on the job, an increased tendency for risk-taking, failure to respond to changes in surroundings or information provided, and difficulty remaining awake when operating machinery or driving a vehicle¹⁸. In fact, the deleterious effects of fatigue and partial sleep

- 4 Kohn LT, Corrigan JM, Donaldson MS. To err is human: Building a safer health system. Washington D.C.: Committee on Quality of Health Care in America. Institute of Medicine, National Academy Press; 1999.
- 5 James JT. A new, evidenced-based estimate of patient harms associated with hospital care. *Journal of Patient Safety*. 2013;9(3):122-8.
- 6 HealthGrades quality study: Patient safety in American hospitals.2004 2004 [cited 2019 April 15]. Available from: http://www.provideredge.com/ehdocs/ehr_articles/Patient_Safety_in_American_Hospitals-2004.pdf.
- 7 Department of Health and Human Services. Adverse events in hospitals: National incidence among Medicare beneficiaries. Washington D.C.: 2010.
- 8 Landrigan CP, Parry, G.J., Bones, C.B., Hackbarth, A.D., Goldmann, D.A., Sharek, P.J. Temporal trends in rates of patient harm resulting from medical care. *New England Journal of Medicine*. 2010;363:2124-34.
- 9 Markary MA, Daniel, M. Medical-error—the third leading cause of death in the U.S. *BMJ Open*. 2016;353:i12139.
- 10 de Vries EN, Ramrattan, M.A., Smorenburg, S.M., Gouma, D.J., Boemeester, M.A. The incidence and nature of in-hospital adverse events: A systematic review. *BMJ Quality and Safety*. 2008;17():216-23.
- 11 Rowin EJ, Licier, D., Pauker, S.G., Kumar, S., Chen, J., Salem, D.N., Do error and adverse event reporting by physicians and nurses differ? *The Joint Commission Journal on Quality and Patient Safety*. 2008;34(9):537-45.
- 12 Weingart NS, Wilson, R. McL., Gibberd, R.W. Epidemiology of medical error. *BMJ*. 2000;320:744. doi: 10.1136/bmj.320.7237.774.
- 13 PSNet (Patient Safety Network). Patient Safety Primer: Systems approach Washington D.C.: Agency for Healthcare Research and Quality; 2019 [updated January]. Available from: <https://psnet.ahrq.gov/primers/primer/21/Systems-Approach?q=medical+error+and+system+issues>.
- 14 Saver C. Beyond expectations: Part 2. *Nursing Management*. 2006;37(11): 17-23.
- 15 Institute for Healthcare Improvement. Protecting 5 million lives from harm n.d. [cited 2019 April]
- 16 Heath S. Leapfrog Ratings Mark Efforts to Improve Patient Safety Initiatives: Xtelligent Healthcare Media LLC; 2018 [cited 2019 April 15]. Available from: <https://patientengagementhit.com/news/leapfrog-ratings-mark-efforts-to-improve-patient-safety-initiatives>.
- 17 The Joint Commission. Issue 48, Health care worker fatigue and patient safety: The Joint Commission 2011 [updated May 14, 2018; cited 2019 April 15]. Available from: https://www.jointcommission.org/assets/1/18/SEA_48_HCW_Fatigue_FINAL_w_2018_addendum.pdf.
- 18 Canadian Centre for Occupational Health and Safety. OSH Answers Fact Sheets: Fatigue Hamilton, Ontario: Canadian Center for Occupational Health and Safety; 2017 [updated August 1; cited 2019 April 15]. Available from: <https://www.ccohs.ca/oshanswers/psychosocial/fatigue.html>.

deprivation have been shown to be equivalent to those associated with alcohol consumption^{19,20,21}.

Fatigue and Errors in Non-Healthcare Settings

Fatigue-related errors and accidents have been documented in many different occupational settings. For example, a study of heavy vehicle crashes in Western Australia found that drivers who spent more than 50% of the trip driving between midnight and 5:59 am were four times more likely to crash than drivers who were not involved in a crash during the previous 12 months²². The risk of a crash was also doubled if long haul heavy vehicle drivers drove more than two hours without a break, a finding that remained significant even when other sleep-related factors were controlled for statistically. Another study found that three continuous hours of night driving can contribute to driving performance errors equivalent to a blood alcohol level of 0.08%, an amount that is considered legally intoxicated in most jurisdictions²³. Finally, the number of public complaints about policemen were increased when officers obtained less sleep in the 24 hours prior to a shift, worked several consecutive night shifts, or reported greater fatigue²⁴.

Studies have also documented that the risk of a fatigue related incident increases dramatically the longer an individual works²⁵. Compared to 8-hour shifts, the likelihood of a fatigue related incident is 13% for 10-hour shifts, and 27% for 12-hour shifts. The risk also increases over successive shifts, with successive night shifts having a greater risk for a fatigue related accident than day shifts. When working hours were increased to 12 hours and the number of consecutive work days decreased to four, the risk for a workplace accident increased by 25%, with a more pronounced effect on night shifts²⁶.

Fatigue, Shiftwork and Errors in Healthcare

The first case that alerted the general public to the role of fatigue in healthcare occurred in 1984 when Libby Zion, an 18-year-old college

student died a few hours after being admitted to the hospital through the emergency room²⁷. Fatigue was considered a contributing cause of her death; several years later the Ad Hoc Advisory Committee on Emergency Services which was convened after her death, recommended that the shifts worked by house staff and attending physicians in emergency services be limited to 12 hours in New York. They also recommended that other physicians working outside of the emergency department be limited to 16-hour shifts, with at least 8 hours off between shifts.

Fatigue also contributed to a fatal medication error that occurred when a labor and delivery nurse mistakenly administered an anesthetic meant for epidural infusion through the patient's peripheral IV line, instead of the penicillin prescribed to treat a streptococcal infection²⁸ (28). In addition to failing to use the bar-coding system for medication administration that had been installed on the unit three weeks earlier, the nurse who made the error, had voluntarily worked 20 hours in a 28 hour period when the error occurred^{28, 29}. Had that error not occurred, she would have completed her scheduled 8-hour shift, working 25 hours during a 32-hour period (she worked her scheduled 8-hour day shift, volunteered to work a second 8-hour shift, and then slept at the hospital from midnight until her next 8-hour shift began at 7 am).

Although most fatigue-related errors result in minimal harm to patients, there were over 1600 errors where worker fatigue was considered a contributing factor to events reported between June 2004 and August 2013 in Pennsylvania²⁹. The majority of these fatigue-related errors reported by facilities to Pennsylvania Patient Safety Reporting System were medication errors (62.1%) or errors related to a procedure or treatment (26.4%). Although the number of fatigue-related events is interesting, it is not known what portion of the total errors reported during that period, were considered to have fatigue as a contributing factor.

Studies have shown that long work hours affect the performance of physicians. Reaction times among anesthesiologists were significantly increased when tested after a 17 hour in-house call period³⁰. Surgical residents were also slower and made more errors after a 24-hour on call period compared to their performance before the 24-hour call period on

- 19 Dawson D, Reid K. Fatigue, alcohol, and performance impairment. *Nature*. 1997;388(6639):235.
- 20 Williamson AM, Feyer AM. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational and Environmental Medicine*. 2000;57(10):649 - 55.
- 21 Maruff P, Falleti, M.G., Collie, A., Darby, D., McStephen, M. Fatigue-related impairment in the speed, accuracy and variability of psychomotor performance: Comparison with blood alcohol levels. *Journal of Sleep Research*. 2005;14(1):21-7.
- 22 Meuleners L, Fraser, M.L., Govorko, M.H., Stevenson, M.R. Determinants of the occupational environment and heavy vehicle crashes in Western Australia: A case-control study. *Accident analysis and prevention*. 2017;99, Part B:452-8.
- 23 Verster JC, Taillard, J., Sagaspe, B., Olivier, B., Phillip, P. Prolonged nocturnal driving can be as dangerous as severe alcohol-impaired driving. *Journal of Sleep Research*. 2011;20(4):585-8.
- 24 Riedy SM, Dawson, D., Vila, B. U.S. police rosters: Fatigue and public complaints. *Sleep*. 2019. Epub November 21, 2018. doi: 10.1093/sleep/zsy231.
- 25 Wong IS, Popkin, S., Folkard, S. Working Time Society consensus statements: A multi-level approach to managing occupational sleep-related fatigue. *Industrial Health*. 2019;57:228-44.
- 26 Folkard S, Lombardi DA. Modeling the impact of the components of long work hours on injuries and "accidents". *American Journal of Industrial Medicine*. 2006;49:953-63.
- 27 Asch DA, Parker, R.M. The Libby Zion Case. *New England Journal of Medicine*. 1988;318:771-5.
- 28 Mason DJ. Good-nurse-bad nurse: Is it an error or a crime? *American Journal of Nursing*. 2007;107(3):11.
- 29 Gardner LA, Dubeck, D. Health Care Worker Fatigue. *American Journal of Nursing*. 2016;116(8):58-62.
- 30 Tsafirir Z, Lproamski, J., Almog, B., Many, A., Wiesel, O., Levin, I. Effects of fatigue on residents' performance in laparoscopy. *Journal of the American College of Surgeons*. 2015;221(1):564-70.e3.

8 virtual reality-based simulation tests³¹. Additionally, emergency room physicians who obtained less than their usual average amount of sleep in 24 hours showed more than a 15-fold increase in prescribing errors³².

Obtaining at least 6 hours sleep appears to reduce the risk of errors. Few of the 36 emergency room physicians participating in the observational study by Westbrook et al³⁰ obtained sufficient sleep, and those most at risk of making an error, obtained on average only 5.6 hours of sleep. When physicians performed surgery after performing another procedure between midnight and 6 am (postnighttime procedures), rates of surgical complications were increased only if the attending surgeon or obstetrician/gynecologist obtained less than 6 hours sleep³³. In contrast, an earlier prospective cohort study of all patients undergoing cardiac surgery found no significant inactions between the amount of sleep the surgeon obtained the night before the procedure (0-3 hours, 3-6 hours, or more than 6 hours sleep) and the occurrence of death or any one of 10 major complications³⁴.

Extended Work Schedules and Quality of Care

While workers in many industries have the option not to work at night or during the weekends, sufficient numbers of nurses must be available 24 hours a day, seven days a week to provide care in hospitals and nursing homes. As a result, many different work schedules have evolved to provide nursing care. For example, during the early part of the 20th century, hospitals were staffed with student nurses who lived at the hospital and provided care 24 hours a day. Between World War II and the mid-1970s and early 1980s, hospitals employed registered nurses, who rotated between three eight-hour shifts (days, evenings, and nights). A nursing shortage in the late 1970s and early 1980s prompted the development of more flexible work schedules. Many different types of schedules were proposed, e.g., the Baylor Plan, the 7-70 plan (seven 10-hour days followed by seven days off), a 7-56 schedule (seven 8-hour

days followed by seven days off)³⁵, and the 4-40 schedule (four 10-hour days and three days off)^{35, 36}. Most hospitals eventually settled on extended shifts (e.g., 12-hour shifts) to cope with the nursing shortage and improve retention.

The majority of staff nurses are now scheduled for three or four 12-hour shifts per week instead of five 8-hour shifts³⁷. These shifts have become extremely popular and are now the predominant scheduling pattern used in hospitals and nursing homes located in the United States.

Positive Aspects of Extended Work Schedules

According to Keller et al³⁸ positive aspects of 12-hour nursing shifts include the ability to work a second job, more days away from work, more free time with friends and family, more time for leisure and social activities, more time for domestic duties, fewer shift "hangovers," and less commuting time. Critical care nurses working 12-hour shifts also reported that the extended shifts were helpful with planning and prioritizing care, improved relationships with patients and relatives, and improved the continuity of care^{39, 40, 41}. These nurses also mentioned increased quality time off from work and increased job satisfaction associated with reduced commuting as benefits of extended shifts^{39, 40, 41}.

On an organizational level, 12-hour shifts are favored because managers need to provide staffing for two shifts per day instead of three shifts, experience less staff turnover and have less overtime³⁸. Research however, contradicts the perception among managers that 12-hour shifts are associated with decreased staff turnover and overtime. For example, among the 21, 942 nurses who participated in the Multi-State Nursing Care and Patient Safety study, those who worked 12-hour shifts reported they were more likely to leave their current position than those who worked shorter shifts³⁷.

- 31 Westbrook JI, Raban, M.Z., Walter, S.R., Douglas, H. . Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: A prospective, direct observation study. *BMJ Quality and Safety*. 2018;27:655-63.
- 32 Westbrook JI, Raban, M.Z., Walter, S.R., Douglas, H. . Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: A prospective, direct observation study. *BMJ Quality and Safety*. 2018;27:655-63.
- 33 Rothschild JM, Kechane, C.A., Rogers, S., Gardner, R., Lipsitz, S.R., Saizberg, C.A., Yu, T., Yoon, C.S., Williams, D.H., Wien, M.F., Czeisler, C.A., Bates, D.W., Landrigan, C.P. Risks of complications by attending physicians after performing nighttime procedures. *JAMA*. 2009;302(14):1565-72.
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- 35 Dison CC, Carter N, Bromley P. Making the change to flex time. *AJN*. 1981;12:2162-4.
- 36 Braddy P. Scheduling alternatives for administrators. . *Nursing forum*. 1987/1988;23(2):70-7.
- 37 Stimpfel AW, Sloane, D. M., Aiken, L.H. The longer the shifts for hospital nurses, the higher the levels of burnout and patient dissatisfaction. *Health Affairs*. 2012;31(11):2501-8; PMID: 3608421.
- 38 Keller SM, Berryman, P., Lukes, P. Effects of extended work shifts and shift work on patient safety, productivity, and employee health. *AAOHN Journal*. 2009;57(12):497-502.
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- 40 McGettick KS, O'Neill, M.A. Critical care nurses-perceptions of 12-hour shifts. *Nursing in Critical Care*. 2006;11:188-97.
- 41 Dwyer T, Jamieson, L., Moxham, L., Austen, D., Smith, K. Evaluation of the 12-hour shift trial in a regional intensive care unit. *Journal of Nursing Management*. 2007;15:711-20.

Although hospital staff nurses are not always paid for working beyond their scheduled shifts^{42, 43, 44}, they are rarely able leave at the end of their shift. All but one of the 895 hospital nurses who participated in the Staff Nurse Fatigue and Patient Safety Study reported working longer than scheduled at least once during the 28 day data gathering period^{45, 46}, and one-third of the participants worked longer than scheduled every shift they worked⁴⁵. In addition, when 8-hour and 12-hour shifts were examined, the likelihood of working longer than scheduled was not meaningfully different between the two shifts (e.g., 85% versus 78% for 8 and 12-hour shifts respectively)⁴⁵. Although critical care nurses worked longer than scheduled on 5201 occasions (86% of the shifts worked), only 1443 (28%) of these shifts were identified as overtime shifts by participants⁴⁶, perhaps because they were not compensated for the care they provided before and after their regularly scheduled shifts. Finally, nearly half of the more than 4,500 newly licensed registered nurses from 13 different states and Washington DC reported working overtime each week, a pattern that has remained stable over the past decade⁴⁷.

Negative Aspects of Extended Work Schedules

When compared to eight hour nursing shifts, 12-hour nursing shifts have been associated with a greater risk of error^{45, 46, 48}, more missed nursing care⁴⁹, greater patient mortality⁵⁰, and decreased patient satisfaction³⁷. Smaller studies, have also documented adverse effects on communication, staff motivation, nurse burnout, and fatigue^{37, 39, 40}. In addition, nurses working extended shifts report feeling a need to re-orient after returning from several days off, experience a lack of continuity in patient care, more stress associated with caring for demanding patients and families for longer periods of time, and have less time for sleep and other activities between shifts³⁹. Critical care nurses who work extended shifts were also more likely to report strug-

gling to stay awake at work compared to those working shorter shifts. Finally, the risk of falling asleep on duty almost doubled when shifts exceeded 8 hours, and increased even more when shifts exceeded 12 or more consecutive hours⁴⁶.

Two-thirds of the nurses participating in the Staff Nurse Fatigue and Patient Safety Study (n=895) reported struggling to stay awake during their work shift at least once during the 28-day data gathering period, and 20% of the 502 critical care nurses who participated in the study, reported falling asleep at least once^{45, 46}. A survey of 1,284 nurse anesthetists (CRNAs) also revealed that 15.7 percent reported falling asleep while providing anesthesia care and 48.8 percent reported observing a colleague engaging in sleep-related behaviors while providing anesthesia care⁵¹. Participants also reported that sleep-related behaviors were more common when providing continuous anesthesia care for more than 16 hours and during the night.

Nurses have one of the highest nonfatal injury rates of all occupations, which may be the consequence of long, cumulative work shifts. The fatigue that accumulates across multiple extended shifts has been hypothesized to lead to an increased risk of injury⁵². In fact, working at least 12 hours/day has been associated with a 37% increased risk of injury⁵³. Although insufficient sleep can contribute to fatigue, muscle strength is also affected by working long hours. For example, when nurses and aids worked three 12 hour shifts over four days, researchers found that that isometric muscle strength measurements showed significant declines in strength at the end of the four day period⁵².

Number of shifts worked per week

Nurses working 12-hour shifts are typically scheduled to work only three or four shifts per week. However, there are significant adverse effects on patient and nurse safety when nurses work more than 40 hours per week or work at night. Specifically, working more than 40 hours per week is associated with an increase in medication errors, falls with

- 42 Nurse Overtime Santa Cruz, CA: Lawyers and Settlements.com; 2012 [updated July 11, 2012; cited 2019 January 31]. Available from: <https://www.lawyersandsettlements.com/lawsuit/nurse-overtime-violations.html>.
- 43 New York State Nurses Association. Southside Hospital Pays Nurses \$1.55 Million Bucks in Back Wages New York: New York State Nurses Association; undated [cited 2019 February 2]. Available from: <https://www.nysna.org/southside-hospital-pays-nurses-155-million-back-wages#.XFikvy2ZN-g>.
- 44 Tenet Settles Calif. Lawsuit for \$85M. Memphis Daily News. 2009 March 13, 2009; Sect. Public Records.
- 45 Rogers AE, Hwang WT, Scott LD, Aiken LH, Dinges DF. The working hours of hospital staff nurses and patient safety. *Health Aff (Millwood)*. 2004;23(4):202-12. Epub 2004/08/21. doi: 10.1377/hlthaff.23.4.202. PubMed PMID: 15318582; PMCID: 15318582.
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- 52 Thompson BJ, Stock, M.S., Banuelus, V.K. Effects of Accumulating Work Shifts on Performance-Based Fatigue using Multiple Strength Measurements in Day and Night Shift Nurses and Aides. *Human Factors*. 2017;59(3):346-56.
- 53 Dembe AE, Erickson JB, Delbos RG, Banks SM. The impact of overtime and long work hours on occupational injuries and illness: New evidence from the United States. *Occupational & Environmental Medicine*. 2005;62():588-97.

injuries, and nosocomial infections^{45, 46, 54}. Just working consecutive 12-hour shifts can increase the risk of error; the number of 12-hour shifts worked in the previous 72 hours significantly increased the risk of a hypoglycemic event among ICU patients receiving intravenous insulin infusions⁵⁵, even when controlling for nurse age and ICU experience. Staffing was not considered a contributing factor to these errors since there was a 1:1 nurse to patient ratio on almost all shifts (97%).

Long weekly work hours can also adversely affect worker health. In fact, Dembe et al, reported that as weekly work hours increased, injury rates to workers increased, suggesting a possible "dose response"⁵³. Men who worked ≥ 45 hours/week were more likely to develop diabetes than males working fewer hours⁵⁶. Shift working men who worked ≥ 45 hours/week had an even higher risk of developing diabetes. Finally, regularly working long hours (measured by average hours worked/week) over a 32-year period was associated with elevated risks of heart disease, non-skin cancer, arthritis, and diabetes, particularly among women⁵⁷. Long weekly work hours have also been associated with harmful daily alcohol consumption among nurses and midwives from Australia and New Zealand⁵⁸.

Effects of Overtime and On-Call Work on Quality of Care

Working longer than scheduled is the norm rather than the exception for hospital staff nurses. A smaller, early study revealed that nurses routinely remained at work after their shift ended to complete their assignments⁵⁹. Participants in the larger Staff Nurse Fatigue and Patient Safety Study left work at the end of their scheduled shifts only 16% of the time (1807/11,334 shifts), working on average 49-55 minutes extra every shift they worked. One hundred nine nurses (12.2%) reported working 16-hour shifts at least once during the 28-day data-gathering

period, and one ICU nurse reported working six 16-hour shifts during the data-gathering period. The longest shift worked was 23 hours and 40 minutes⁴⁵. Working overtime increased the odds of making at least one error, no matter how long the shift was originally scheduled⁴⁵. Working overtime after a 12-hour shift however, was associated with the greatest risk of making an error.

The long hours worked by nurses on a daily basis are also associated with more needlestick injuries, catheter-associated urinary tract infections, decubitus ulcers, hypoglycemia episodes, and increased mortality^{50, 55, 60, 61, 62}. Young and middle-aged participants in the Nurses' Health Study II who worked more frequent overtime (> 40 hours/week) also had an increased risk of developing Type II diabetes⁶³. Even when shifts are shorter e.g., 8 hours instead of the 12-hour shifts common in the United States, the majority of nurses who worked overtime reported higher levels of chronic fatigue than those who took more time off between shifts⁶⁴. They also reported less alertness, decreased ability to concentrate when providing care and less effective communication. Finally, working long hours, whether associated with 12-hour shifts, or greater number of hours worked/week, is associated with decreased job satisfaction and higher levels of nurse burnout^{37, 58}.

Only a few studies have examined mandatory overtime but the findings suggest the practice may be risky. For example, studies have linked mandatory overtime with higher risk for needlestick and other work-related injury, work-related illness, and missing more than 2 days of work because of a work-related injury or illness^{65, 66}. Although there were no differences however, in the risk of making an error when mandatory overtime was compared to voluntary overtime⁴⁵, working longer than scheduled was associated with a greater risk of making an error.

On-call requirements, once confined to operating rooms and PACUs have now spread to all areas of nursing practice including obstetrics, medical/surgical units, special procedures departments, and hospice

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units⁶⁷. This practice is extremely common with 40% of 2273 nurses participants in the Nurse Worklife and Health Study reporting that their jobs had on-call requirements⁶⁸. On-call requirements can be significant: For example, nurses attending the 2005 Massachusetts Nursing Convention⁶⁹ reported on call requirements ranged from 0-48 hours in posted work schedules, that they voluntarily took call for an additional 8-24 hours in a posted work schedule, and that mandated on call hours were reported to be as high as 16 hours in the same period. Hospice nurses have reported working 1) 8 am to 5 pm Monday through Friday and being expected to be on-call one night per week; 2) working Monday through Friday 8 am-5 pm, then taking call from 5 pm Friday to 8 am Monday; and 3) working 7 consecutive days (as well as being on-call throughout the evening and night), then having the next 7 days off⁷⁰. A recent survey of certified registered nurses anesthetists indicated that more than half of the 325 participants worked more than 16 hours when on call, and that one-third reported making a medical error due to fatigue⁷¹.

Effects of Working a Second Job

Approximately 10% of employed population in US work more than one job in a week and 3% work two or more jobs in a 24-hour period⁷². Studies suggest that an even greater percentage of nurses work more than one job. For example, in 2009, a report from the US Bureau of Labor Statistics indicated that 6.3% of registered nurses held multiple jobs⁷³, whereas a more recent study⁴⁷ suggested that up to 13% of US nurses hold a secondary job.

Data from Bureau of Labor Statistics US American Time Use Study between 2003-2011, showed that those who worked multiple jobs had a reduced sleep duration compared to those who worked only one job.

Men working multiple jobs slept on average less than 40 minute/day less on a weekend day than men who worked only one job. Working at night had greatest impact on sleep for women who worked two jobs, reducing sleep by almost an hour compared to those who didn't work at night⁷⁴.

Fatigue, Shiftwork, and Nurse Health

Since all physiological and behavioral functions are affected by circadian rhythms, the time of day when work occurs is important. Overall capacity for physical work is reduced at night^{75, 76, 77}. Reaction time, visual search, perceptual-motor tracking and short-term memory are worse at night than during the day^{78, 79}. On-the-job performance also deteriorates, railroad signal and meter reading errors are more common at night, minor errors occur more often in hospitals, and switchboard operators take longer to respond to phone calls⁸⁰. Two significant nuclear power plant accidents (Three Mile Island and Chernobyl), and the environmentally disastrous grounding of an oil tanker (Exxon Valdez) occurred during the early morning hours when vigilance is at its lowest.

Although the human circadian rhythm strongly favors sleeping during the nighttime hours, nurses and other healthcare personnel must remain awake and alert at night in order to protect patient safety. Nurses are not the only workers required to work at night; police officers, physicians, air traffic controllers, pharmacists, taxi drivers, security guards, customer service representatives, and commercial drivers often are required to work at night. In fact, approximately 15% of the US workforce regularly works hours outside of the 9 am to 5 pm period⁸¹, and 12% to 28% of working women are night shift workers⁸². Although night shift work is necessary to provide round the clock ser-

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vices, working at night is associated with numerous health and safety risks including injuries, obesity, metabolic syndrome, diabetes, and negative reproductive outcomes^{60, 83, 84, 85, 86}.

Needlestick injuries are more common among nurses who worked at least three-night shifts in the seven-day period prior to the needlestick. Nurses who worked 9 or more night shifts in a 28 day period were more likely to report a needlestick injury than those who worked less than four night shifts in a 28 day period⁶⁴. Other injuries are also more common among shift workers. For example, a review of hospital workers' compensation claims found that evening and night shift hospital employees were at greater risk of sustaining an occupational injury than day shift workers, with those on night shifts also reporting more severe injuries than day shift workers⁸⁷. Larger studies that included a variety of industries, also reported that evening and night shift workers have a higher risk of being injured than day shift workers^{53, 88}.

Night shift workers are also at high risk for impaired glucose tolerance and the development of diabetes^{63, 83}. Even night shift workers whose body mass is within normal range, are more likely to develop impaired glucose tolerance than those who work day shift⁸³. Among participants in the Danish Nurse Cohort (28,732 nurses who were followed for at least 15 years), those who worked night or evening shifts were more likely to have a statistically increased risk of developing diabetes (OR=1.59, OR=1.2 respectively) compared to day shift nurses, even in the fully adjusted models which included BMI⁸⁹. In contrast, researchers using data from the Nurses' Health Study I and the Nurses' Health Study II, found that although there was a positive association between the number of years working rotating shifts and the develop-

ment of Type II diabetes, that this relationship appeared to be partially mediated by weight gain^{63, 90}.

There is considerable epidemiologic evidence for a link between shift work, obesity and metabolic syndrome^{84, 91, 92, 93}, and some evidence that those who work 12-hour night shifts may be at particularly high risk for obesity^{94, 95}. Among 724 nurses and midwives in Poland aged 40-60 years, both current and cumulative night work was associated with obesity (BMI \geq 30 kg/m²). Nurses and midwives who worked 8 or more night shifts per month were almost four times (OR=3.9) more likely to be obese compared to nurses and midwives who worked only day shifts⁹². An Australian study involving 2,494 nurses and midwives found that those who worked night shifts were 1.15 times more likely to be overweight or obese than nurses and midwives who worked during the day⁹⁶. A recent meta-analysis also showed that night shift work is associated with a 57% greater risk of metabolic syndrome, and that female night shift workers have a slightly greater risk of developing metabolic syndrome than male night shift workers⁹³. Even more compelling, a recent meta-analysis involving 28 studies demonstrated that night shift workers have a 1.23 times greater risk of being overweight or obese and that permanent night shift workers have a 29% greater risk of being overweight or obese than rotating shift workers⁹⁷. Longer night shifts e.g., 10 or 12 hour shifts, also dramatically increase the risk of obesity⁹⁸. Finally, data from the Nurses' Health Study II suggests that age may play a role, with night shift work before age 25 associated with fewer risk factors for cardiovascular disease and cancer compared to night shift work at older ages⁹⁹.

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In 2007, the World Health Organization officially classified night shift work as a potential carcinogen¹⁰⁰. The mechanisms underlying the association between night shift work and the development of cancer remains uncertain. Based on their case control study comparing Norwegians with and without a history of breast cancer, Erdem et al.¹⁰¹, hypothesized that the shorter telomere lengths found among those who had a more intensive history of night shift work (e.g., working 6 consecutive night shifts for a period of more than 5 years) might be associated with higher risk of cancer, particularly breast cancer among night shift workers. Others have shown that the circadian disruptions associated with night shift work have triggered faster tumor growth in animal models¹⁰².

A recent report¹⁰³, however, contradicts earlier smaller studies which suggested an increased incidence of breast cancer among female night shift workers^{101, 104, 105, 106}. This large study included data about night shift work from three prospective studies (Million Women Study, EPIC-Oxford, and UK Biobank) involving almost 800,000 women and included a meta-analysis of seven studies involving 1.4 million women, found that night shift work, even prolonged exposure to night shift work (e.g., 30 years or more), was not associated with an increase in breast cancer incidence.

Many of the hazards associated with working at night are associated with disrupted circadian rhythms and the often-limited sleep obtained by shift workers. Not only do night shift nurses report more fatigue than day shift nurses¹⁰⁷, studies have shown that they obtain less sleep^{48, 108, 109}, and experience both more excessive sleepiness¹⁰⁹ and more insomnia than nurses who work during the day¹¹⁰.

Nurses and Sleep

Few nurses obtain the 7-8 hours of sleep recommended by the American Academy of Sleep Medicine^{111, 112}. Self-reported sleep times range between 4.3 and 6.7 hours^{113, 114, 115, 116, 117}, with nurses who work night shifts typically obtaining somewhat less sleep than nurses who work during the day. As a result, they typically report higher levels of fatigue^{2, 114, 118}. Additionally, nurses who obtain less than 7 hours sleep/night are three times more likely to complain of excessive daytime sleepiness than nurses who obtain at least 7 hours of sleep¹¹⁵.

Objective recordings using actigraphy also have also demonstrated that nurses working 12-hour night shifts obtain significantly less sleep than nurses working 12-hour day shifts. For example, ICU nurses who worked 12-hour night shifts obtained on average 5.5 to 5.68 hours of sleep compared to an average 6.7 and 6.79 hours of sleep for day shift

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nurses^{48, 119} n days off, nurses obtained on average 8.53 hours of sleep, suggesting that they were compensating for insufficient sleep on work nights/days⁴⁸. Given the extended sleep recorded on their days off, the short sleep times recorded by nurses working 12-hour shifts appear to reflect the lack of opportunity to sleep between work shifts rather than an inability to sleep.

The majority of night shift nurses revert to a normal day-wake schedule on their days off¹²⁰, with only a small number of night shift nurses (2%) remaining on a night shift schedule on their days off. Others switch halfway between nights and days rather than switch completely to day shift on their days off. Three-fourths of night shift nurses, however, switch completely to a day shift schedule on their days off. These nurses use a variety of strategies to adapt to the internal desynchronization that Gamble and her colleagues¹²⁰ have compared to the jet lag experienced by flying back and forth between Tokyo and San Francisco every few days. Although most night shift nurses who switch to days on their days off, opt to sleep later on the day before they start night shift work, 25% choose to switch between days and nights by staying up for more than 24 hours, usually just before their first scheduled night shift¹²⁰. Older and more experienced night shift nurses (median age 36 years) obtain less sleep on work days than younger night shift nurses, and are also more likely to choose to stay awake for more than 24 hours prior to their first scheduled night shift¹²⁰. Other studies have reported that instead of staying up for more than 24 hours prior to their first night shift, some night shift nurses staying up for more than 24 hours after their last night shift¹¹⁹. Neither approach is recommended since both involve significant sleep deprivation and are likely to result in excessive sleepiness.

Night shift nurses, however, are not the only ones who experience excessive sleepiness. One-quarter of all staff nurses, regardless of the shift they worked, reported excessive daytime sleepiness¹²¹. And almost two-thirds of nurses participating in the Staff Nurse Fatigue and Patient Safety Study reported "struggling to stay awake on duty" at least once during the 28-day data-gathering period^{45, 106}. Drowsy episodes and actually falling asleep on duty weren't confined to night shifts; 47% of the periods where nurses reported "struggling to stay awake on duty" and 28% of the actual sleep episodes occurred between 6 am and midnight¹¹³. The risk of falling asleep at work was almost doubled when shifts exceeded 8 hours (odds ratio=1.9, P=0.01), and increased even more when shifts exceeded 12 consecutive hours (odds ratio=2.4, P= 0.01)⁴⁶.

A similar number of participants reported at least one episodes of drowsy driving (66.6%) during the 28-day data-gathering period

and 30 nurses (3.4%) reported struggling to stay awake driving home after every shift they worked¹¹³. Even though nurses reported drowsy driving episodes after working shifts of 8.5 hours or less, the risk for a drowsy driving episode doubled when working 12.5 hours or more (odds ratio=2.00, P<0.01). Over half of those who worked exclusively day shifts (58%) reported at least one episode of drowsy driving on the way home work, and almost 80% of those working exclusively night shifts reported difficulties with drowsy driving. In fact, working at night significantly increased the risk of drowsy driving with nurses reported struggling to stay awake driving home after 30% of the night shifts they worked.

Recommendations

While it is likely that most night shift nurses will experience a certain amount of fatigue associated with working at night due to circadian factors, there are several strategies that institutions and individual nurses can adopt to minimize their fatigue and increase patient safety. These strategies, as well as other strategies to decrease nurse fatigue on all shifts, will be discussed in this section.

Minimizing nurse fatigue and improving patient safety requires buy-in by both hospital staff nurses and their employers. Since health care organizations are responsible for the safety of all patients, they are obligated to address fatigue among employees. In fact, according to the American Nurses Association, employers are responsible for providing "a work schedule that provides for adequate rest and recuperation between scheduled shifts," and compensation adequate enough that individuals do not feel "compelled to seek supplemental income through overtime, extra shifts and other practices that contribute to worker fatigue"¹²². Individual nurses are responsible for obtaining adequate sleep and ensuring that they are able to remain awake and alert throughout their scheduled work shift.

Institutional Strategies to Minimize Fatigue Among Nurses

Appropriate scheduling practice can minimize staff nurse fatigue. The direction of rotating shifts, number and duration of consecutive shifts, rest breaks between and during shifts, and expectations regarding on-call work need to be considered when designing work schedules for nurses. A clockwise rotation pattern (days, evenings, nights), rather than a counterclockwise pattern (days, nights, evenings), is usually recommended since most adults find it easier to extend their subjective day by delaying their bedtime rather than to shortening their subjective day by advancing their bedtime¹²³.

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- 120 Gamble KL, Motainfwe-Reif, A.A., Hida, A., Borsetti, H.M., Servick, S.V., Ciariieglio, C.M., Robbins, S., Hicks, J., Carver, K., Hamilton, N., Wells, N., Summar, M.L., McMahon, D.G., Johnson, C.H. Shift Work in Nurses: Contribution of Phenotypes and Genotypes to Adaptation. *PLOS One*. 2011;6(4):e18395.
- 121 Suzuki K, Ohida T, Kaneita Y, Yokoyama E, Ychiyama M. Daytime sleepiness, sleep habits and occupational accidents among hospital nurses. *Journal of Advanced Nursing*. 2005;52(4):445-53.
- 122 American Nurses Association. Assuring Patient Safety: The Employer's Role in Promoting Healthy Nursing Work Hours for Registered Nurses in All Roles and Settings Silver Springs, MD2006 [cited 2008 August 12]. Available from: <http://www.nursingworld.org/MainMenuCategories/ThePracticeofProfessionalNursing/workplace/Workforce/NurseFatigue.aspx>.
- 123 Kecklund G, Sallinen, M., Axelsson, J. Optimizing shift scheduling. In: Kryger M, Roth, T., Dement, W.C., editor. *Principles and Practice of Sleep Medicine* (6th ed). Philadelphia: Elsevier; 2017. p. 742-9.

Adequate time off between shifts is critical, especially if nurses are expected to rotate between day and night shifts. A minimum of 48 hours off duty is recommended when rotating from night shift to day shift^{39, 124}, and no more than 3 or 4 consecutive day or night shifts should be scheduled^{123, 125}. The amount of time off duty between each shift is critical since off-duty times of less than 12 hours typically result in sleep durations of only 4 to 6 hours between shifts^{113, 114, 115, 116, 123}.

Unfortunately, the current 12-hour shift schedules, favored by hospital staff nurses do not allow sufficient time for nurses to obtain the recommended 7-8 hours sleep between shifts. Nurses scheduled to work 12 hour shifts typically work at least 12.5 hours, often staying on average 49-55 minutes longer than scheduled in order to complete their work^{45, 46, 126, 127}. Even if they leave work at the end of their scheduled shift, 11.5 hours off duty is often insufficient time for nurses to commute to and from work, unwind, carry out social and household obligations, and obtain sufficient sleep^{25, 123}. Given the high likelihood of work-related fatigue accumulating when nurses work 12-hour shifts, attention should be paid to providing adequate time off between blocks of shifts. At least two consecutive days off should be scheduled for those working traditional 8-hour day shifts, with more consecutive days off required for recovery when working extended shifts or at night²⁵.

Careful thought should also be given to scheduling on-call shifts. As mentioned earlier, when nurses are on call, they often exceed the number of hours recommended per day and/or the number of hours recommended per week, by the American Nurses Association and the Institute of Medicine^{125, 128}. Managers of units where nurses are expected to work on-call should ensure that nurses have at least 6-8 hours off-duty before any on-call period, and create systems to relieve nurses who have worked during their on-call hours, and are scheduled to work their regular shift following the on-call period⁶⁷.

As mentioned earlier in this paper, the 12-hour shift pattern with several consecutive days off, has resulted in an increasing number of nurses who are working two jobs (e.g., working full-time at one hospital

and full-or-part-time at another hospital)^{47, 129}. To minimize the fatigue that accumulates when working numerous extended shifts with limited time for recuperation, policies restricting the number of hours that can be worked at other facilities, and at their own institution should be developed¹²⁹. Managers can also monitor self-scheduling practices on their units to ensure that nurses do not select schedules that put patients at risk for a fatigue-related error, and refrain from praising nurses who extend their 12-hour shift (staying over) or come in on their day off to cover a shift¹²⁹.

Other strategies to minimize staff nurse fatigue and improve patient safety include ensuring that nurses have duty-free breaks, encourage napping during work breaks and discouraging a "supernurse" unit culture. Studies have shown that many nurses report being unable to take a single 30-minute break during their entire shift^{24, 130}. In California, where staffing ratios require that there are sufficient staff members available so that nurses can take a break, only 74% of the nurses surveyed agreed that they were able to take a 30-minute break on most days¹²⁷. In other states, just over half of the nurses surveyed (51%) reported they were able to take a 30-minute break on most days. Only 21% of ICU nurses managers estimated that nurses working on their units were always able to take a 30 minute break during their shift³¹.

Numerous studies have shown that duty-free breaks with the option to nap improve alertness and performance during night shifts and extended shifts^{132, 133, 134, 135, 136}. A systematic review, that included 13 laboratory and field studies, also showed that napping during the night shift consistently reduced sleepiness and performance without interfering with sleep the next day¹³⁷. The benefits of even a short nap on performance and fatigue outweigh the risk of sleep inertia, a transient state, lasting no more than 15-20 minutes, of impaired cognitive and motor performance that may occur immediately upon awakening¹²³.

At least two studies describe the implementation of naps during night shifts on nursing units. The first study by Scott et al., included duty-free work breaks, and permission to nap during their breaks on

- 124 Johnson K, Chisholm, A., Weatherman, P. Work schedules and job performance: What's the link? *Nursing Management*. 2008;39:44-7.
- 125 American Nurses Association. Addressing nurse fatigue to promote safety and health: Joint responsibilities of registered nurses and employers to reduce risks. Washington D.C.: American Nurses Association; 2014 [cited 2019 April 22]. Available from: <http://nursingworld.org/MainMenuCategories/Policy-Advocacy/Positions-and-Resolutions/ANAPositionStatements/Position-Statements-Alphabetically/Addressing-Nurse-Fatigue-to-Promote-Safety-and-Health.html>.
- 126 Hobbs BB, Wightman, L. Fatigue and Critical Care Nurses: Considerations for safety, health and practice. *Nursing Critical Care*. 2018;13:6-13.
- 127 Stimpfel AW, Aiken, L.H. Hospital staff nurse' shift length associated with safety and quality of care. *Journal of Nursing Care and Quality*. 2013;28:122-9; PMID: 23023189.
- 128 Institute of Medicine. Keeping Patients Safe: Transforming the Work Environment of Nurses . Washington, DC: National Academy Press; 2004.
- 129 Smith-Miller CA, Shaw-Kokot, J., Curro, B., Jones, C.B. An integrative review: Fatigue among nurses in acute care settings. *Journal of Nursing Administration*. 2014;44:487-94.
- 130 Rogers AE, Hwang WT, Scott LD. The effects of work breaks on staff nurse performance. *J Nurs Adm*. 2004;34(11):512-9. Epub 2004/12/09. PubMed PMID: 15586072; PMID: 15586072.
- 131 Edwards MP, McMillan, D.E., Fallis, W.M. Napping during breaks on night shift: Critical care nurse managers' perceptions. *Dynamics*. 2013;24(4):30-5.
- 132 Smith-Coggins R, Howard SK, Mac DT, Wang C, Kwan S, Rosekind MR, Sowb Y, Balise R, Levis J, Gaba DM. Improving alertness and performance in emergency department physicians and nurses: The use of planned naps. *Annals of Emergency Medicine*. 2006;48(5):596-604e3. doi: 10.1016/j.annemergmed.2006.02.005.
- 133 Signal TL, Gander, P.H., Anderson, H., Brash, S. Scheduled napping as a countermeasure to sleepiness in air traffic controllers. *Journal of Sleep Research*. 2009;18:11-9.
- 134 Bonnefond A, Muzet, A., Winter-Dill, A.S, Bailloeuil, C., Bitouze, F., Bonneau, A. Innovative working schedule: Introducing one short nap during the night shift. *Ergonomics*. 2001;44:937-45.
- 135 Baulk SD, Fletcher, A., Kandelaars, K.J., Dawson, D., Roach, G.D. A field study of sleep and fatigue in a regular rotating 12-hour-shift system. *Applied Ergonomics*. 2009;40:694-8.
- 136 Amin MM, Graber, M., Ahmad, K., Dragos, M., Hossain, S., Zuzana, B., Cheney, W., Gold, M.S., Gold, A.R. 872012;1428-1433.
- 137 Ruggiero JS, Redeker, N.S. Effects of napping on sleepiness and sleep-related performance deficits in night-shift workers: A systematic review. *Biologic Research in Nursing*. 2014;16:134-42.

night shift as part of a larger fatigue countermeasures program for nurses^{138, 139}, whereas a later study included plans for six nursing units at two hospitals to develop and implement a viable napping protocol¹⁴⁰. Both studies reported that nurses who napped felt more alert and had fewer difficulties with drowsiness on the drive home. Although only one of the six units approached to participate in Geiger-Brown and colleagues' pilot study¹⁴⁰ were actually able to implement the nap protocol, the nurses who tried napping reported they fell asleep about half of the time and slept on average for 31 minutes. Symptoms of sleep inertia were relatively rare; nurses reported feeling "very groggy" after 1.2% and "a little groggy" after 20.3% of the naps. After 52.6% of the naps, the nurses reported feeling "refreshed and alert." After the three-month pilot project ended, the nurses modified the nap protocol to add 5 minutes before the 30-minute nap to allow for settling into bed and 5 minutes after the nap to transition back to work. Over a three year period, the napping protocol was implemented hospital-wide after convincing the human resources department to revise their policy against employees sleeping during their breaks¹⁴¹.

Despite the substantial evidence that napping during work breaks has on fatigue and performance, many nurses and administrators are reluctant to encourage adoption of this strategy to improve performance and reduce fatigue^{131, 138-140}. When ICU nurse managers were surveyed about perceptions of nurses napping during their breaks at night, the majority indicated that their colleagues (72%) and senior leaders (96%) were either neutral or disapproving of napping on the night shift¹³¹. Other nurse managers expressed concerns about the possibility of nurses combining their breaks in order to take a nap, that

nurses would come into work fatigued and rely on being able to get a nap during the shift, the lack of a suitable place for nurses to take a nap, and the possibility of family members complaining about the fact that nurses were allowed to nap on their breaks. Several of the nurse managers approached by Geiger-Brown's team¹⁴⁰, vetoed the idea of implementing a napping protocol on their units because of their concerns about sleep inertia, insufficient staffing, lack of suitable spaces for nurses to nap, and a "general bias against nurses sleeping at work."

Heavy workloads and insufficient staffing are often cited as reasons nurses are unable to take duty-free breaks^{142, 143, 144, 145, 146, 147}. Nurses regularly report putting their patients' needs ahead of their own^{148, 149}, and are often reluctant to take breaks if it will increase their colleagues' workloads¹³⁸. Not only do many nurses feel that there is a stigma associated with acknowledging fatigue, they also report that peer pressure dissuades them from taking a duty-free break^{144, 150}.

Nurse leaders can combat the "supernurse" culture¹⁴⁴ by providing: 1) adequate staffing; 2) emphasizing the need to take regular breaks; 3) formally scheduling and enforcing meal periods and other short breaks throughout the shift; and 4) encouraging nurses to eat their meals away from the nursing unit^{67, 129, 146, 151}. Some hospitals have hired part-time nurses who work 3-4 hours/day in order to ensure staffing is adequate during meal periods, while others have added a resource nurse to give nurses a one-hour off-unit meal break during 12 hour shifts^{151, 152}.

Encouraging frequent duty-free breaks may also improve nurse well-being, since nurses who took more frequent breaks report higher job satisfaction and lower body mass indexes than nurses who took less frequent breaks^{153, 154}. Finally, the failure to pay nurses for working

- 138 Scott LD, Hofmeister N, Rogness N, Rogers AE. An interventional approach for patient and nurse safety: a fatigue countermeasures feasibility study. *Nurs Res*. 2010;59(4):250-8. Epub 2010/05/15. doi: 10.1097/NNR.0b013e3181de9116. PubMed PMID: 20467338.
- 139 Scott LD, Hofmeister N, Rogness N, Rogers AE. A Fatigue Countermeasures Program for Nurses: An Interventional Approach. *Sleep*. 2008;31(Suppliment):A345.
- 140 Geiger-Brown J, Sagherian, K., Zhu, S., Wieroniey, M.A., Blair, L., Warren, J., Hinds, P., Szeles, R. Napping on the Night Shift: A Two Hospital Implimentation Project. *American Journal of Nursing*. 2016;116(5):26-33.
- 141 Stokowski LA. Should night shift nurses nap at work? : *Medscape*; 2016 [updated August 5; cited 2019 April 29]. Available from: <https://www.medscape.com/viewarticle/866836>.
- 142 U.S. Department of Labor Wage and Hour Division. Fact Sheet #53-The Health Industry and Hours Worked Washington D.C.: U.S. Department of Labor; 2009 [updated July 2009; cited 2019 April 28, 2019]. Available from: <https://www.dol.gov/whd/regs/compliance/whdfs53.pdf>.
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- 152 Witkoski A, Dickerson, V.V. Hospital staff nurses'work hours, meal periods and rest breaks: A review from an occupational health nurse perspective. *AAOHN Journal*. 2010;38(4):13-21.
- 153 Han KT, A.M., Storr, C.L., Geiger-Brown, J. Job stress and work schedules in relation to nurse obesity. *Journal of Nursing Administration*. 2011;41:488-95.
- 154 Nahm E-S, Warren, J., Zhu, S., An, M., Brown, J. Nurses' self-care behaviors related to weight and stress. *Nursing Outlook*. 2012;60:e23-e31.

through their lunch break can be quite costly for the institution^{155, 156}. Federal labor laws require that employees are completely relieved from duty when eating regular meals, and must be paid if they perform any duties during their meal period¹⁴².

Individual Strategies to Minimize Fatigue

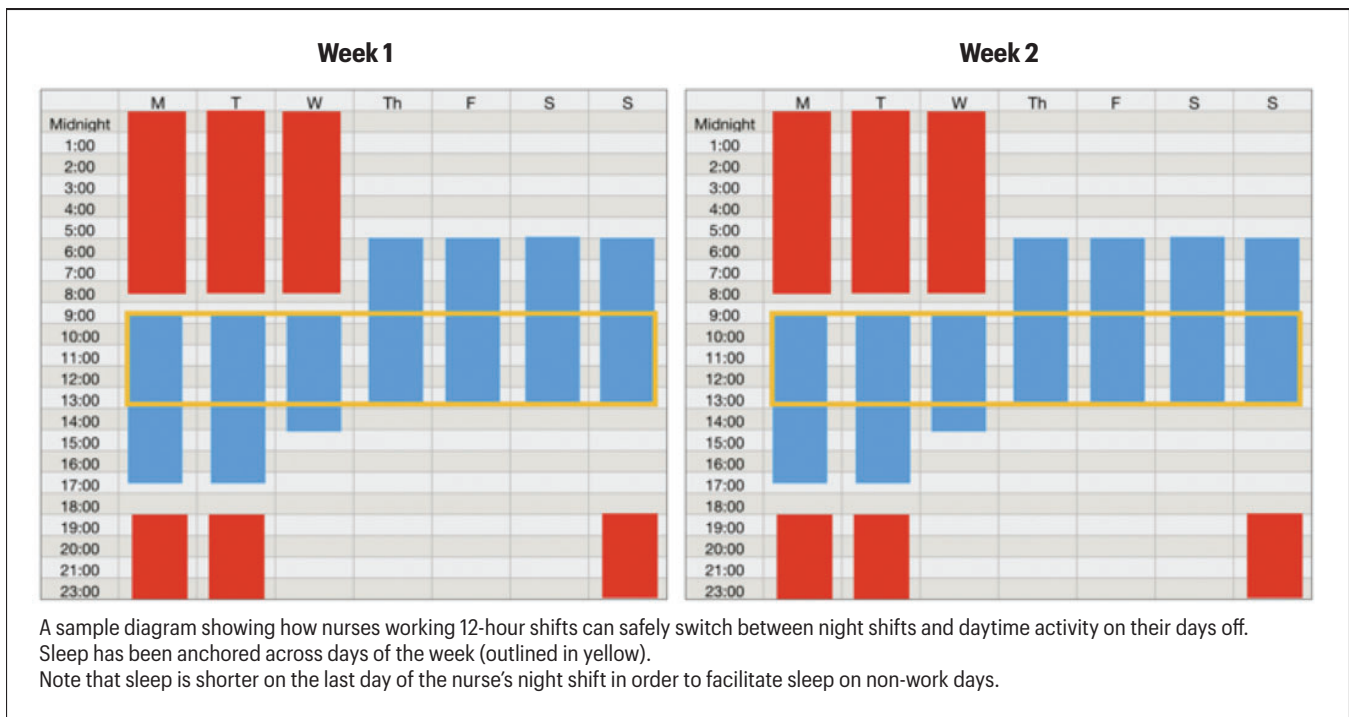
Nurses can minimize fatigue and improve patient safety by obtaining sufficient sleep before and between scheduled work shifts, considering the impact of multiple jobs have on their level of fatigue and ability to practice safely, using fatigue countermeasures such as caffeine, napping, and breaks to increase their alertness, and educating themselves on the impact of fatigue and methods to mitigate its affects^{125, 126, 157, 158, 159, 160, 161}.

Although it is difficult to carve out the time necessary to obtain at least 7 hours of sleep when working 12-hour shifts, obtaining sufficient sleep is critical for patient safety and maintaining health. In fact, the American Nurses Association's current campaign, Healthy Nurse Healthy Nation¹⁴⁸, has emphasized the need for obtaining sufficient sleep along with interventions to improve nutritional intake and increase exercise among registered nurses. Their recommendations are based on the findings of the Health Risk Assessment survey conducted between 2013 and 2016, which revealed that 42% of the respondents reported obtaining 6 hours of sleep or less, and 14% had nodded off or fallen asleep driving in the past 30 days¹¹². Because they included all registered nurses who answered their survey (n=9117) in their analysis (and not just the 40% of participants who reported working in hospitals

and acute care settings), it is impossible to compare their findings to prior studies focusing on sleep among hospital staff nurses.

Since adaptation to night shift is affected not only by how much sleep nurses obtain between shifts and on their days off, night shift nurses need to pay particular attention to their sleep/wake patterns on their days off. The no-sleep strategy adopted by 25% of the night shift nurses studied by Gamble et al.¹²⁰, should be avoided because of the significant sleep deprivation and impairment it produces on the first night shift. Instead, nurses should identify a consistent 4-hour period when they sleep each day, to "anchor" the circadian sleep wake cycle and reduce sleep disturbances^{162, 163}. Although it sounds impossible, once implemented it can be practical and sustainable¹⁶⁴. The following diagram, based on a figure using 8 hour night shifts¹²⁰, shows how sleep anchoring would work for nurses working 12-hour night shifts.

- 155 American Nurses Association. Rest breaks matter for patient safety Washington D.C.: American Nurses Association; 2019 [cited 2019 April 28]. Available from: <http://www.theamericannurse.org/2013/07/01/rest-breaks-matter-for-patient-safety/>.
- 156 Haefner M. Nurse sues Texas hospital for allegedly working through lunch without pay Chicago, IL: Becker Hospital Review; 2016 [updated June 29, 2016; cited 2019 April 28]. Available from: <https://www.beckershospitalreview.com/legal-regulatory-issues/nurse-sues-texas-hospital-for-allegedly-working-through-lunch-without-pay.html>.
- 157 Caruso CC, Baldwin, C.M., Berger, A., Chasen, E.R., Landis, C., Redeker, N.S., Scott, L.D., Trinkoff, A. Position statement: Reducing Fatigue associated with sleep deficiency and work hours in nurses. *Nursing Outlook*. 2017;65:766-8.
- 158 Emergency Nurses Association. White Paper: Nurse Fatigue Des Plaines, IL: Emergency Nurses Association; n.d. [cited 2019 April 22]. Available from: <https://www.ena.org/docs/default-source/resource-library/practice-resources/white-papers/nurse-fatigue.pdf>.
- 159 Haifa S, Smith, B.A. The Effect of Staff Nurses' Shift Length and Fatigue on Patient Safety and Nurses' Health: From the National Association of Neonatal Nurses. *Advances in Neonatal Care*. 2015;15(5):113.
- 160 NANN. The Impact of Advanced Practice Nurses' Shift Length and Fatigue on Patient Safety: Position Statement #3057. *Advances in Neonatal Care*. 2012;12(3):189-200.
- 161 American Association of Nurse Anesthetists. Patient Safety, Fatigue, Sleep and Work Schedule Effects American Association of Nurse Anesthetists; 2015 [cited 2019 April 22]. Available from: [https://cms.aana.com/docs/default-source/practice-aana-com-web-documents-\(all\)/patient-safety-fatigue-sleep-and-work-schedule-effects.pdf?sfvrsn=790049b1_4](https://cms.aana.com/docs/default-source/practice-aana-com-web-documents-(all)/patient-safety-fatigue-sleep-and-work-schedule-effects.pdf?sfvrsn=790049b1_4).
- 162 Mollicone DJ, Van Dongen, H.P., Rogers, N.L., Dinges, D.F. Response surface mapping of neurobehavioral performance: testing the feasibility of sleep schedules for space operations. *Acta Astronaut*. 2008;63:833-40.
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Like any sleep schedule adopted by night shift workers, family support and encouragement is helpful when implementing this schedule. In addition, night shift nurses can facilitate sleep by using light-blocking shades when sleeping during the day, avoiding the use of electronic devices prior to sleep, and avoiding caffeine and nicotine for three hours prior to their sleep period¹⁶⁵. Finally, nurses who snore loudly, have breathing pauses while sleeping, experience excessive sleepiness or difficulties maintaining sleep, are obese and/or post-menopausal should be evaluated for obstructive sleep apnea.

Caffeine is frequently recommended as a fatigue countermeasure. Although its performance enhancing effects e.g., improvement on cognitive tasks, enhancement of mood, reduction of acute fatigue, as well as its adverse effects on sleep are well known^{166, 167, 168}, it is not clear if

these improvements in performance translate directly into improved safety¹⁶⁹.

The half-life of caffeine varies between 3 and 7 hours¹⁷⁰ with the most profound effects on alertness occurring during the first to two hours after ingestion. Eighty-five percent of adults in the U.S. consume on average 164-200 mg of caffeine daily in the form of coffee, tea, and cola^{171, 172}. Since individuals who consume caffeine daily often become desensitized to its alerting effects^{173, 174}; its widespread use, particularly among shift workers, may limit caffeine's effectiveness as a fatigue countermeasure. If nurses wish to use caffeine to improve their alertness, they should first decrease or eliminate their social use of caffeine. In 1995, Walsh and his colleagues¹⁷⁵ recommended that night shift workers consume a single dose 250-400 mg of caffeine (approximately 2.5-

- 165 American Nurses Association. Healthy Nurse, Healthy Nation Washington D.C.: American Nurses Association; 2017 [cited 2019 April 22]. Available from: <http://www.nursingworld.org/>
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- 175 Walsh JK, Muehlbach, M.J., Schweitzer, P.K. Hypnotics and caffeine as countermeasures for shiftwork-related sleepiness and sleep disturbance. *Journal of Sleep Research*. 1995;4(Suppl 2):80-3.

4.0 8 oz cups of coffee) between 22:30 and 01:20. Alerting effects are expected to persist until approximately 05:30 and rarely interfere with daytime sleep beginning at 09:00. Unfortunately, there are no other studies which provide guidance regarding the optimal timing or the dosage of caffeine needed to increase alertness when working at night.

Studies have shown that napping before a scheduled night shift and/or during work breaks can also improve alertness and performance at night^{138, 176, 177, 178, 179}. However, the findings of these studies are difficult to compare since there was significant variability in the duration and timing of naps studied during the night shifts, with durations ranging from 10 minutes to 120 minutes¹³¹. Most of the naps studied occurred between midnight and 4 am. One of the few studies involving nurses, concluded that there were no significant differences in alertness when Brazilian nurses took early (between midnight and 3 am) or late (between 3 am and 6 am) naps¹⁷⁶. Although sleep was 90 minutes shorter following a night shift when they napped, there were no differences in when they fell asleep after working the night shift or in their perceived sleep quality. Given that these nurses obtained on average 138.3 minutes of sleep during their night shifts, it is encouraging that napping at night did not interfere with their ability to sleep the next day. More research, however, is needed to identify the optimal timing and duration of these scheduled naps¹⁷⁹, with particular consideration given to the needs of nurses who work 12-hour night shifts, and often quite limited duty-free breaks.

Because few nursing programs include information on sleep and sleep disorders and/or the hazards of fatigue in their curriculum¹⁸⁰, hospital staff nurses need to educate themselves on these topics. One of the best resources, the NIOSH Training for Nursing on Shiftwork and Long Work Hours¹⁸¹ is available online at <https://www.cdc.gov/niosh/docs/2015-115/default.html>. This course is free and offers continuing education credits. Additional information is available in Ronda Hughes' book, *Patient Safety and Quality: An Evidenced-Based Handbook for Nurses* (also available free online at <https://archive.ahrq.gov/professionals/clinicians-providers/resources/nursing/resources/nursesdbk/index.html>).

Summary

Although the Institute of Medicine's report, *Keeping Patients Safe: Transforming the Work Environment of Nurses*¹²⁸, recommended that nurses not be allowed to provide direct patient care for more than 12 consecutive hours in 2004, there is evidence that that this recommen-

dation has not been widely adopted. Work schedules have not been changed to benefit patient safety and nurses⁴⁷. In fact, more nurses are being required to take call, with limited, if any, adjustment of their scheduled shifts the next day. And almost half of newly licensed nurses report working overtime on a regular basis and 12% report working mandatory overtime⁴⁷. Mandatory overtime is now restricted in 18 states, with a few states limiting the number of consecutive hours a nurse can provide direct patient care (often to 12 or 14 hours) and/or requiring breaks of 8-10 hours between shifts¹⁸².

Despite increasing awareness of the dangers to patient safety and the health of the nursing workforce associated with insufficient sleep and long work hours often without duty-free breaks to eat and attend to other biological needs, the majority of staff nurses still prefer to work 12-hour shifts. Although extended shifts are associated with increased errors, increased risk of needlestick and other injuries, and insufficient sleep, these empirical findings are unlikely to change the predominant schedule pattern for nurse work shifts in the United States. Therefore, it is critical that healthcare institutions and managers work with staff nurses to change the culture of tolerance of fatigue, emphasizing that it poses an unacceptable risk to patient and nurse safety⁶⁹. Provision of adequate staffing so that nurses are able to take duty-free breaks, allowing nurses to nap during their breaks on night shift, limiting the use of on-call periods, and limiting the number of hours worked per day and consecutive shifts worked each week, will reduce the fatigue experienced by many staff nurses. Managers can also monitor the number of hours overtime worked by individual nurses, encourage their staff to obtain sufficient sleep and engage in recuperative activities during non-work hours, and refrain from encouraging self-sacrifice by praising staff members who extend their 12-hour shift (staying over to complete patient care) or coming in to cover a shift¹²⁹.

None of these strategies to decrease nurse fatigue and improve patient safety are new. In fact, they are quite similar to the strategies recommended by numerous professional organizations such as the American Academy of Nurses, the American Association of Critical Care Nurses, the American Association of Nurse Anesthetists, the American Association of Operating Room Nurses, the American Nurses Association, the Emergency Nurses Association, and the National Association of Neonatal Nurses^{125, 126, 157, 158, 159, 160, 161} over the past decade.

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- 178 Ruggiero JS. Correlates of fatigue in critical care nurses. *Research in Nursing & Health*. 2003;26(6):434-44.
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