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Original Review

Student Midwives' Duty Hours: Risks, Standards, and Recommendations

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Introduction: A growing body of literature has emerged describing the risks of extended-duty shifts and sleep deprivation. Worldwide, midwifery organizations have not adopted standards for practitioner or student duty shifts. This project reviews the literature related to extended-duty shifts in an effort to develop evidence-based recommendations for student nurse-midwives/student midwives (SNMs/SMs).

Methods: A comprehensive literature search was conducted through electronic databases, major journals, and reference lists published in English since January 2001. Primary research studies evaluating sleep deprivation and shift duration were included. Studies that did not include the target population (shift workers) and those that formed conclusions related to extended-duty shifts greater than 30 hours were excluded. In addition, an extensive worldwide review of duty-hour recommendations from more than 300 health care organizations was conducted.

Results: A total of 40 studies met the inclusion criteria. Extended-duty shifts (those greater than 12 hours) increased the risk for cognitive and physical functional errors, safety concerns, and decreased quality of life from sleep deprivation. Cognitive function errors included attention lapses, visual tracking errors, decreased mentation and immediate recall, and decreased learning capacity. Physical errors included decreased motor skills and slowed reaction times in clinical simulations. These deficits led to an increased risk of motor vehicle accidents, needle sticks, and performance equivalent to unsafe blood alcohol concentrations. An overall decrease in quality of life and job satisfaction was linked to extended-duty shifts. Seven organizations for medical residents or advanced practice nurses have developed policy statements on duty shifts, with extended-duty shift limitations between 12 and 24 hours.

Discussion: The risks associated with extended-duty shifts may inhibit the development of SNMs/SMs into competent practitioners and place patients at risk. It is recommended that midwifery education programs adopt evidence-based limitations for the duty shifts of SNMs/SMs.
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INTRODUCTION

The National Sleep Foundation has recommended healthy adults obtain 7 to 9 hours of sleep per day, with an emphasis on nighttime sleep.[1] This recommendation is not consistently being met, with up to 30% of US workers receiving fewer than 6 hours of sleep per night, according to the Centers for Disease Control and Prevention (CDC).[1] As Kryger noted,[2] medical residents reported fewer than 5 hours of sleep per night on average, making them a particularly sleepy subpopulation. A growing body of literature has emerged in recent years describing the risks of extended-duty shifts (defined as those longer than 12 hours) in all occupations including health care, aviation, and transportation. Decreased sleep may be due to the type of industry, hours worked, available hours for sleep, and stress.[1] Consequences of sleep loss for the general population include increased risk for cardiovascular disease and obesity, among others.[1]

In health care, concerns related to sleep deprivation and extended-duty shifts have included patient safety, increased risks of medication errors, and personal safety risks for individuals who work these extraordinarily long hours. Although there is no consensus on the length of extended-duty shifts, for the purposes of this review, shifts greater than 12 hours will be considered extended duty (Table 1).

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Many organizations, including the Accreditation Council for Graduate Medical Education (ACGME),[3] Institute of Medicine (IOM),[4] the National Academy of Sciences (NAS),[5] and the European Working Time Directive (WTD),[6] have created regulations limiting duty shifts for health care workers. For example, in 2003, the ACGME[3] imposed limitations of 24-hour consecutive shifts for medical residents, whereas the NAS[5] has recommended shift durations of only 12 hours for medical students. Worldwide, midwifery organizations have not yet adopted standards for maximum duty shifts in hospitals and other practice settings. The desire to provide continuity of care during labor, an inherently unpredictable and potentially lengthy process, may promote the use of extended-duty shifts by obstetric providers and their students.

Sleep loss is more likely to affect newly learned skills than well-known activities.[2] Therefore, during the learning process student nurse-midwives/student midwives (SNMs/SMs) are at risk for alterations in the learning process because of sleep deprivation. Evidence on SNMs/SMs is underdeveloped; therefore, for the purposes of this review, research from related health care disciplines was used. The risks associated with extended-duty shifts, those greater than 12 consecutive hours, put health care workers at risk and can lead to patient injury and death.[1] It is suggested that these deficits can lead to learning difficulties and inhibit the abilities of SNMs/SMs to build the necessary foundations for entrance into clinical practice and to develop across the continuum into expert practitioners. This project reviews the literature related to extended-duty shifts within health care in an

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Quick Points

- Quality and length of sleep have proven to be critical in learning, cognition, and physical performance.
- Creating a culture of safety that promotes learning and quality of life while advocating for safety is necessary within the midwifery community.
- Professional organizations and education institutions should develop clinical hour limitations for SNMs/SMs while maintaining the relationships between the SNM/SM and the patient during the unpredictable birth process.
- These recommendations may include limiting consecutive on-call hours per day and total on-call time per week.
- These limitations should encourage consistent nocturnal sleep to allow for SNMs/SMs to obtain the necessary experiences and knowledge base for entry into practice while increasing patient and student safety, student quality of life, and students' advancement from novice to expert.

effort to develop evidence-based limitations on the consecutive duty shifts of SNMs/SMs, while attempting to maintain the relationships between the patient and her midwife through the unpredictable birth process. Terminology related to duty shifts used in this review is defined in Table 1.

METHODS

The data for this review came from English-language articles published from January 2001 through January 2012. This allowed for the inclusion of more recent research since the publication of the ACGME guidelines in 2003. Primary research articles related to the risks of sleep deprivation to patients and health care workers were obtained from an electronic search of the PubMed, CINAHL, ERIC, and PsycINFO databases. Relevant literature contained the following keywords, searched in combination: "sleep/sleep deprivation/sleep loss/sleep debt," "midwife/student nurse midwife," "resident/resident physician/medical student," "shift work/duty period/duty hours/on call/on duty," "medical error/medication error," "patient safety/patient security," and "learn*/master/study/skill/comprehension/demonstrate/knowledge." Articles for inclusion in the review were studies on sleep deprivation in residents, medical students, physicians, and nurses. Systematic reviews and case studies were examined for additional relevant citations. Using these strategies, 40 articles were found. Articles were excluded if they did not reflect the health care context or examined duty shifts longer than 30 consecutive hours.

Furthermore, a review of duty-hour recommendations from more than 300 worldwide health care organizations was conducted. An Internet search of professional, student, and government organizations was limited to policies on consecutive duty shifts and on-call duration for professionals and students. The reference lists from these policy statements were searched for additional research that met inclusion criteria.

RESULTS

Results from the literature were compiled and categorized by the authors on the basis of the primary focus of the study

Table 1. Glossary of Commonly Used Terms on Sleep and Work Schedules

Term	Definition
Duty shifts	The actual time the on-call SNMs/SMs are called into the facility for a procedure.
Extended-duty shifts	Work schedules having a longer than normal workday; however, there is no clear consensus nor are there regulations about the length of the extended workday. Some sources regard time worked in excess of 8 hours to be extended periods, whereas others consider shifts longer than 12 hours to be extended shifts.
Fatigue	A response to predefined conditions that has physiologic and performance consequences. Fatigue is identified as deterioration in human performance arising as a consequence of changes in the physiologic condition. Factors contributing to fatigue include, but may not be limited to, time on task, time and duty period duration, time since awake when beginning the duty period, acute and chronic sleep debt, circadian disruption, alertness, and cognitive performance.
Off duty	A period of uninterrupted time during which an individual is free from work-related duties.
On-call	A designated period during which the SNM/SM is available to respond to patient care needs for unplanned circumstances or urgent or emergent procedures.
Sleepiness	A physiologic state. Deprivation or restriction of sleep increases sleepiness. Sleep reverses sleepiness.
Traditional schedules	Defined as schedules currently based on the ACGME standards for residents or current standard of 12-hour shifts for RN, dependent on population referred to.[3,43]

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; SNMs/SMs, student nurse-midwives/student midwives.

measure and outcome. According to Kryger's text, the *Principles and Practice of Sleep Medicine*,[2] medical errors, serious accidents, cognitive and memory problems, and hypercapnia and hypoxia are all consequences of sleep deprivation. Articles were categorized to reflect these risks, including cognitive deficits, changes in physical abilities, alterations in quality of life, and safety risks for patients and employees, all related to sleep deprivation. Forty studies were included from 12 countries (Australia, Brazil, England, Germany, China, Ireland, Israel, Korea, Pakistan, South Africa, Sweden, and the United States), composed of prospective and retrospective data on volunteer participants, residents, physicians, and nurses. Of the 40 studies, 17 were descriptive studies, 13 were randomized controlled trials, and 9 were correlational studies. One meta-analysis was available on extended-duty shifts and sleep deprivation. Sample sizes ranged from 11 to 2737 participants. The maximum number of resident to patient contact hours evaluated was 5888. A worldwide policy review, through an extensive Internet search, yielded 7 organizations with policy statements or recommendations limiting medical professionals.

Cognitive Function

Fifteen studies evaluated the effects of sleep deprivation and shift duration on cognitive function (Table 2). Findings typically evaluated healthy participants after 24 hours of sleep deprivation, which is comparable to the maximum amount of sleep deprivation SNMs/SMs may encounter in their education programs. After 24-hour shifts, residents' cognitive performance and vigilance decreased, with reports of being "too exhausted to learn."[7-13] Researchers used the Karolinska Sleepiness Scale, which is a validated 9-item tool used to assess sleepiness. Scores range from 1 to 9, and lower scores are more indicative of sleepiness. Research showed that mental fatigue in clinical decision making declined by 1.3 points, from 7.1 points after the first postcall night (95% confidence interval [CI], 6.5-7.7) to 5.8 points on the third night postcall (95% CI, 5.0-6.7).[14] This mental fatigue in students took as long as 2 days to return to normal levels after extended shifts.[14] Lim and Dinges[9] found in a meta-analysis that individuals who were severely sleep deprived, based on receiving fewer than 4 hours of sleep per night on average, had more difficulty learning and a decreased ability to concentrate. Kim et al[15] discovered that in an analysis of 58 residents, 70.7% were considered chronically sleep deprived with fewer than 6 hours of sleep per day. Although sleep deprivation was greatest in the period following an on-call shift, self-reported sleep on average (SD) was only 5(1.2)hours, regardless of on-call status.[15] This demonstrates acute and chronic sleep deprivation among residents. In a study evaluating cognitive performance and sleep deprivation in shifts fewer than 24 hours, deficits in learning and attention were found in shifts as short as 15 hours.[15] Reimann et al[13] showed that when performing 24-hour on-call duty, residents slept significantly less (4.3 hours) than their coworkers who worked only day-call shifts (6.5 hours) or only night-call shifts (5.9 hours). When comparing sleepiness, one 11-hour night shift was equivalent to working an entire 24-hour shift,[13] which was reflected in decreased attention information processing and visual tracking (increased time from 33.84 to 37.66 seconds), motor functioning (increased time from 8.87 to 8.92 seconds), and recall and learning capacity (increased time from 10 to 10.03 seconds).[16] These deficits were measured based on neurophysical testing (Digit Span [WAIS III], Span Spatial [WMS III], Trail Making Tests A and B, and Rey Auditory Verbal Learning [RAVLT]) after shifts.[16]

Physical Function

Five studies correlated sleep deprivation and extended-duty shifts with physical performance in a clinical setting (Table 3). In 2 separate studies, extended-duty shifts were shown to significantly decrease motor function and physical performance based on standardized computer testing and laboratory mannequin simulations.[7,8] Pilcher et al[11] found in their study of 24 college students that tasks requiring attention and vigilance worsened after only one night of acute sleep deprivation. Decreased performance was significant, as well as increased reaction time.[11] In addition, the number of errors nearly doubled, from 3 to 10 errors ($P < .001$), after a 24-hour shift, based on computerized data in a virtual-reality minimally invasive surgery simulation.[17] Participants reported fatigue and sleepiness, causing an increase in the amount of time needed to complete tasks.[17] These physical deficits showed that with decreased sleep, reaction times and physical performance decreased from baseline testing prior to a shift. Correlations can be made between physical function, performance, shift duration, and patient safety.[11]

Quality of Life

The sleep literature discussed in depth the relationship between excessive sleepiness and life activities, including family life and life expectancy.[2] Twenty studies on quality of life and job satisfaction (Table 4) examined the effects of extended-duty shifts on personal and work-related quality of life. According to the available research, elements of quality of life evaluated included stress, sleepiness, burnout, exhaustion, satisfaction, relationships at work and home, and health of workers. Maslach[18] defined burnout as the development of mental exhaustion and personal detachment because of chronic occupational stress. In a study by Lim et al,[9] reports of stress increased and sleep efficiency decreased when individuals received fewer than 4 hours of sleep per night. Although effects of fatigue have been shown with all shift lengths, decreased job satisfaction becomes more prevalent in shifts longer than 12 hours according to findings from qualitative reports. In addition, more than half of residents (57%) reported burnout with traditional ACGME schedules (24-hour shifts)[19] when evaluated with the Maslach Burnout Inventory,[18] a validated instrument considered the standard for measuring emotional exhaustion, depersonalization, and personal achievement. Residents reported decreased empathy toward patients when working 24-hour shifts, which correlated with decreased patient communication and increased burnout among residents.[20] In a study by Zheng et al,[21] reports of sleepiness and stress increased in shifts longer than 24 hours. This led to increased levels of high-sensitivity C-reactive protein (CRP), from normal levels ranging from 0.01 to 0.03 to 0.15 mg/dL and norepinephrine from normal

Table 2. Studies Addressing Effects of Sleep on Cognitive Function

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Flinn and Armstrong 2011 Ireland[7]	Correlational	30 medical residents	Pre- and postcall testing of cognitive function and clinical decision making based on Mindstream Global Assessment Battery	Cognitive, attention, and processing scores worsened after 24-hour shifts	Related cognitive function to clinical work Participants served as their own controls Sleep and nap hours not controlled for Sleep hours measured by self-report (less rigorous)
Gohar et al 2009 United States[44]	Descriptive	39 medical residents	Daily working memory capacity testing and sleep diary	Increased basic mathematical errors after 30-hour call shifts	Sleep hours measured by actigraphy Statistically controlled with a noncall month Patient acuity or census not controlled for
Kim et al 2011 Korea[15]	Descriptive	58 medical residents	Sleep diary, questionnaires, and neurophysical evaluation using the Pittsburgh Sleep Quality Index (PSQI), the Stanford Sleepiness Scale (SSS), the Epworth Sleepiness Scale (ESS), and the Beck Depression Inventory (BDI)	Difficulty learning and attention deficits after 15 hours of work and sleep deprivation	Data collected through subjective memory recall Sleep deprivation group division not based on data Sleep hours measured by self-report
Lim and Dinges 2010 United States[9]	Meta-analysis	70 articles	147 cognitive tests on effects of short-term sleep deprivation	Reduced cognitive performance after 24 hours of sleep deprivation	Testing dissimilarities (eg, length, demands) Studies conducted at different labs Results from general population, not medical professionals
Malmberg et al 2010 Sweden[14]	Correlational	22 physicians	Sleep diary, Karolinska Sleepiness Scale after 24-hour shifts	Mental fatigue significantly increased after 16-hour shifts, with 2 days to return to normal levels	Homogenous specialties studied (anesthesia and pediatric ENT) Confirmed self-reported and objective sleep hours data
Papp 2004 United States[10]	Descriptive	149 medical residents	Qualitative assessment of sleepiness, sleep loss, and performance	Residents who worked 24-hour shifts reported being "too exhausted to learn"	Subjective data Mixed specialties, including obstetrics
Qureshi et al 2010 Pakistan[12]	RCT	32 medical residents	Evaluation of memory, concentration, and attention after a 6- and a 24-hour call shift	Increased lapses in attention, especially verbal recall and logic, after a 24-hour shift	Small sample size Homogenous group Hours slept not reported

Continued

Table 2. Studies Addressing Effects of Sleep on Cognitive Function

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Reimann et al 2009 Germany[13]	RCT	38 medical residents	Sleepiness and cognitive performance before and after duty	After an 11-hour night shift, similar sleepiness to a 24-hour shift	Single-blinded study Residents placed in sleep groups Hours slept not reported
Suozzo et al 2011 Brazil[16]	Correlational	38 medical residents	Neurophysical testing (Digit Span [WAIS III], Span Spatial [WMS III], Trail Making Tests A and B, and Rey Auditory Verbal Learning [RAVLT]) after 12-hour night shifts	Attention, visual tracking, mental flexibility, information processing, motor functioning, immediate recall, and learning capacity all decreased after 12 hours on call over night	Hours slept not reported Residents had clinic and overnight call shifts, similar to many SNM/SM programs

Abbreviations: ENT, ear, nose, throat; RCT, randomized control trial; SNM/SM, student nurse-midwife/student midwife.

levels ranging from 110 to 269 to 289 pg/mL; these are inflammatory body markers related to overall health and stress levels.[21] Howard et al,[22] using the Multiple Sleep Latency Test and Stanford Sleepiness Scale, showed that participants who worked shifts over 24 hours tested at the level for diagnosis of clinical sleep disorders, including narcolepsy, sleep apnea, and stress-related fatigue. Despite these findings, increased overall satisfaction was not seen until shift lengths decreased to 14 hours.[23]

Results from several studies revealed that as many as 70% of participants had difficulty falling asleep, despite feeling exhausted, after shifts lasting 12 to 15 hours.[15,24–26] Despite this exhaustion, nurses reported increased job satisfaction with 12-hour shifts and increased fatigue with 8-hour shifts,[27] which is likely related to the number of shifts required per week (3 versus 5).

Safety

Correlations between duration of sleep and safety were made in 18 of the studies reviewed (Table 5). Landrigan et al[28] showed a 36% increase in errors in extended-duty shifts of 24 hours (136.0/1000 patient-days), compared with 16 hours (100.1/1000 patient-days). Another finding was the relationship between sleep deprivation and equivalent blood alcohol concentrations. Acute sleep deprivation of 24 hours (or one extended-duty shift) has been shown to correlate to a blood alcohol concentration of .089%, over the legal driving limit for most states, based on reaction time and simulated driving tests before and after interventions of sleep deprivation or alcohol consumption.[29] Drivers who had adequate sleep hit zero cones, whereas sleep-deprived drivers hit 20 cones and drivers who consumed alcohol hit 24 cones.[29]

Trinkoff et al[30] correlated nurse safety with sleep deprivation in their study. Their research found that in nurses working greater than 50 hours per week, working night shifts, and working more than one job, percutaneous injuries (needle sticks) increased by almost 2 times (relative risk [RR], 1.63; 95% CI, 1.17-2.26) with shifts of 13 hours or more.[30] Medical residents reported attention lapse and fatigue as the most common contributing factors in needle sticks (64% and 31% of injuries, respectively).[31] Medication errors have also been more prevalent with increased sleepiness, with physicians making double the amount of errors, 6.2% in shifts greater than 18 hours, compared with 3.4% (odds ratio [OR], 1.72; 95% CI, 1.02-2.89) in shifts fewer than 18 hours.[32] In a study of medical students by Frey et al,[33] it was found that performance declined over the course of a 24-hour shift. Declining performance peaked after working 16 consecutive hours,[33] suggesting that shifts of fewer than 16 hours would allow for optimum overall performance.

According to the CDC,[1] up to 20% of all fatal car accidents are linked to drowsy driving. The relationship of occupational effects on concentration and reaction time in motor vehicle accidents (MVAs) is a well-recognized area of study. When working 24 hours, residents showed a 15% reduction in response time on a single task after 17 hours,[34] leading to an increased risk for MVAs.[35] Scott et al[36] found the risk for MVAs involving nurses almost doubled (OR, 1.84; 95% CI, 1.06-3.20) with shifts of more than 12.5 hours compared with shifts of fewer than 8 hours. In addition to the overall risk for accidents with extended-duty shifts, almost 30% of residents reported falling asleep while driving after a 24-hour shift.[37]

Policy Statements

In a comprehensive worldwide Internet search of online information and e-mail correspondence with each organization, 7 organizations for medical residents or advanced practice nurses had clearly defined policy statements on duty shifts. In 2003, the AGCME limited residents' shifts to 24 hours, with an additional period of 6 hours for continuity care or educational activities, with a maximum of 80 hours worked per week.[3] This limitation is very similar to the recommendations of the IOM[4] and WTD[6] for consecutive hours worked. These recommendations allow for additional hours for education activities but do not reflect the amount of classroom work that most midwifery programs have in conjunction with clinical work. Two nursing organizations, the Academy of

Table 3. Studies Addressing Effects of Sleep on Physical Function

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Eastridge et al 2003 United States[17]	RCT	35 medical residents	Prospective assessment of technical dexterity when rested and acutely sleep deprived	Significant increase in number of errors in postcall testing (24-hour shift and acutely sleep deprived)	Small sample size Hours slept not reported
Flinn and Armstrong 2011 Ireland[7]	Correlational	30 medical residents	Pre- and postcall testing of cognitive function and clinical decision making using the Mindstream Global Assessment Battery	Decreased physical skills scores after extended work shifts	Related cognitive function to clinical work Participants served as their own controls Sleep and nap hours not controlled for Sleep hours measured by self-report
Gordon et al 2010 United States[8]	RCT	25 medical residents	Simulator laboratory testing using a mannequin and clinical scenarios when rested and after a 16-, 24-, or 30-hour shift	Significant decrease in performance in postcall simulator testing (24-hour shift and acutely sleep deprived)	Sleep hours not reported Tested in rest and sleep-deprived states
Pilcher et al 2007 United States[11]	RCT	24 college students	Task administration throughout a continuous wakefulness period	Decreased vigilance and attention throughout 24 hours of wakefulness	College students Tested at regular intervals throughout a night of sleep deprivation
Qureshi et al 2010 Pakistan[12]	RCT	32 medical residents	Evaluation of motor skills performance after a 6- and a 24-hour call shift	Increased reaction times and decreased vigilance after a 24-hour shift	Small sample size Homogenous group (pediatric residents) Hours slept not reported

Abbreviation: RCT, randomized clinical trial

periOperative Registered Nurses[40] and the National Association of Neonatal Nurses,[41] have published policies of a maximum of 12 consecutive hours worked in a 24-hour period for nurses. The National Academy of Sciences[38] has also made the recommendation of 12-hour shifts for medical students. In addition, many state legislatures have limited nursing shifts to not exceed 12 hours for nurses and other health care workers.[39] Limitations on the hours health care students, including SNMs/SMs, can be continuously clinically active have yet to be addressed in state laws. For a summary of these policy statements see Table 6.

DISCUSSION

Extended-duty shifts can lead to limited hours available for sleep, less than the recommendation of 7 to 9 hours per night by the National Sleep Foundation.[1] Findings from an extensive literature review indicate that for health workers, extended-duty shifts may cause cognitive and physical errors by providers, leading to safety concerns and an overall decrease in the quality of life. Cognitive errors may include attention lapses, visual tracking errors, decreased mentation, worsened immediate recall, and decreased learning capacity.[6-12] Physical errors include decreased motor skills, worsened simulator testing, and increased time necessary to react to changes in simulations,[2,7,12,13] which lead to an increased risk of MVAs, needle sticks (percutaneous injury), equivalence of blood alcohol concentrations over the legal limit, and laboratory testing errors.[14-21] A balance between shorter shift duration and quality of life is necessary; however, defining ideal shift duration is not possible according to the available research. Based on the available data, 12-hour shifts may improve the ability of SNMs/SMs to balance quality of life, improve planning and prioritization of care, improve relationships with patients, and increase motivation and ability to learn, while promoting adequate sleep.[40]

Sleep deprivation related to extended-duty shifts may not only impede the clinical abilities of an SNM or SM, but also the ability to return to normal function for didactic classroom work within the same week and advance toward becoming an expert practitioner. As Benner noted, adequate learning experiences must be provided to develop across the learning

Table 4. Studies Addressing Effects of Sleep on Quality of Life

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Dorrian et al 2006 Australia[24]	Descriptive	23 RNs	Daily recordings of actual work hours, sleep, and fatigue	RNs who worked 13-hour shifts reported difficulty falling asleep and using sleep aids	Small sample size Subjective reports of sleep hours
Friesen et al 2008 United States[45]	Cross-descriptive	111 medical residents	Regressional meta-analysis of hours worked, sleep quality, stress, and teamwork	After 30-hour shifts, residents stated they did not get enough sleep to feel rested and were more stressed	Poor response rate (59%) Subjective responses and perceived stress reported
Geiger-Brown et al 2012 United States[25]	RCT	80 RNs	Sleep actigraphy, sleep diaries, the Karolinska Sleepiness Scale (KSS), and behavioral sleepiness tests at baseline and after three 12-hour shifts	RNs showed high result of sleepiness and fatigue after a 12-hour shift	Objective data Compared day-shift and night-shift sleepiness
Gohar et al 2009 United States[44]	Descriptive	39 medical residents	Daily working memory capacity testing and sleep logs	After 30-hour shift residents reported increased sleepiness and less overall sleep, with sleep deprivation recovery of 4 days	Sleep hours measured objectively Control with a noncall month Patient acuity or census not controlled for
Howard et al 2002 United States[22]	Correlational	11 residents	Retrospective assessment of physiologic and subjective sleepiness in traditional schedules[3] and after extended sleep	Residents who worked 24-hour shifts had a baseline Multiple Sleep Latency Test (MSLT) at the level for diagnosis of clinical sleep disorders, including narcolepsy and sleep apnea	Small sample size Participants tested in 3 states of sleepiness Showed difference between perceived onset of sleep and EEG results
Howard et al 2003 United States[46]	RCT	12 medical residents	Simulation after extended sleep and traditional schedule	Most disturbance scores increased and performance decreased over a 24-hour shift	Small sample size Sleep hours not reported Test performed after different shift lengths
Josten et al 2003 Netherlands[27]	RCT	134 RNs	Effects of a 9-hour shift on fatigue	12-hour shifts associated with more satisfaction and increased free time; 9-hour shifts compared with 8-hour shifts—reported more fatigue and health complaints and decreased satisfaction with schedule	Subjective data Hours slept not reported

Continued

Table 4. Studies Addressing Effects of Sleep on Quality of Life

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Kenyon et al 2007 United States[26]	Descriptive	1013 RNs	Survey of work load, call schedule, and fatigue	67.7% of RNs working 12-hour shifts had experienced sleep deprivation	Subjective data collection Participants from all aspects of clinic including front-desk personnel and medical assistants
Kim et al 2011 Korea[15]	RCT	58 medical residents	Groups of severely, moderately, and non-sleep-deprived testing of cognition using 3 neuropsychological evaluations	15-hour shifts—sleep deprivation and stress increased	Data collected through subjective memory recall Sleep deprivation group division not based on data Sleep hours measured by self-report
Landrigan et al 2008 United States[18]	Correlational	220 medical residents	Reports on work, sleep, errors, and education before and after ACGME changed limits on residents' hours	Increased rate of medication order errors with 24- to 30-hour shifts, decreased burnout with decreased shift length to 28.5 hours	Self-reported data
Lockley et al 2004 United States[47]	Correlational	20 medical residents	Sleep diaries when working traditional schedule vs 16-hour schedule	When working 16 hours compared with 24 hours, there was an average of 5.8 hours more sleep per night	Small sample size Subjective data collection, objectively validated
Mautone 2009 United States[23]	Correlational	64 medical residents	Questionnaires on job satisfaction from elimination of 24-hour call to 14-hour shifts	Increased satisfaction with change from 24- to 14-hour shifts	Testing at the beginning of medical education, showing less intellectual discrepancies Subjective data Hours slept not reported
Papp et al 2004 United States[10]	Descriptive	149 medical residents	Qualitative assessment of sleepiness, sleep loss, and performance	Residents who worked 24-hour shifts reported poor health habits and difficulties in relationships	Subjective data Mixed specialties, including obstetrics
Passalacqua and Segrin 2011 United States[20]	Descriptive	93 medical residents	Self-reported stress and burnout and empathy and communication measurements	Decreased empathy and patient-centered communication at the end of a 24-hour shift	Subjective self-reported data Patient perception not considered for validation

Continued

Table 4. Studies Addressing Effects of Sleep on Quality of Life

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Richardson et al 2007 England[40]	Descriptive	127 staff members	Focus groups and questionnaires on patient relationships and quality of life	With three 12-hour shifts, reported improved planning/prioritizing care, better relationships with patients, and more time off work, leading to increases motivation and decreased tiredness	Self-reported subjective data Homogenous group (critical care staff)
Sargent et al 2009 United States[19]	Descriptive	648 medical residents and medical faculty	Questionnaire on quality of life	57% of medical residents reported burnout with ACGME traditional schedule	Low response rate (7% of residents, 24% of faculty) Self-reported sleep hours
Scott et al 2006 United States[48]	Descriptive	502 RNs	Continuous logbooks on hours worked and sleepiness	20% of RNs working 8- to 12-hour shifts reported falling asleep with working; risk of falling asleep doubled for shifts > 8 hours	Randomized sample Homogenous response group, almost 90% white and >90% women Subjective data
Surani et al 2007 United States[49]	Correlational	16 medical residents	Comparison of night-float residents and non-post-call residents	75% of RNs reported sleep loss as having a major impact on their lives when working 14-hour shifts	Small sample size Subjective data
Zheng et al 2006 United States[21]	RCT	22 medical residents	CRP and norepinephrine blood levels after 6- and 30-hour shifts	Higher levels of inflammatory markers after 30-hour shifts	Small sample size Standardized data collection times Collected objective biomarkers Hours slept not reported

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; CRP, C-reactive protein; RCT, randomized clinical trial; RNs, registered nurses.

continuum over the course of the curriculum.[41] A competent nurse will react differently than a proficient nurse, and proficiency, for example, in clinical assessment skills or medication administration, develops over time. Many accredited programs in the United States and Europe have adopted curricula that provide concurrent classroom and clinical experiences to develop proficiency. Student activities may include conducting outpatient visits, having on-call time, attending women for labor and birth in and out of hospitals, doing home visits, attending classes, and doing homework. Many students also work while in school to support themselves and their families. In some clinical sites, being on-call for 24 hours may result in being awake for 24 consecutive hours or longer. Although there are many benefits of integrating classroom and experiential learning,[42] the extent of these demands on students' time, in combination with inadequate sleep, may inhibit their ability to learn. Decreased alertness and incomplete memory consolidation alter development and synthesis toward proficiency in practice.

With the application of the findings in this review to SNMs/SMs, safety may decrease as shift duration increases. In addition, SNMs/SMs may have improvements in quality of life and decreased burnout with shorter shifts, possibly allowing for better clinical performance, increased graduation rates, and improved retention rates within the profession post-graduation.

Because of the nature of the work, practicing midwives may be on-call and available for patient care activities for long durations. Practicing midwives are ethically responsible for preparing for these extended-duty hours through adjusting clinical hours and the use of restorative naps. It is also the responsibility of SNMs/SMs to prepare for their duty shifts;

Table 5. Studies Addressing Effects of Sleep on Safety

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Ayas et al 2006 United States[31]	Descriptive	2737 medical residents	Web-based surveys on work schedule and needle sticks	Increased percutaneous injuries (needle sticks) related to lapses in concentration and fatigue with 24-hour shifts	Self-reported work hours Data not validated by direct observation
Barger et al 2005 United States[35]	Descriptive	2737 medical residents	Web-based survey on shift length, and self-reported MVAs	Each extended work shift increased risk of an MVA by 9.1%	Subjective data Caffeine consumption was not controlled Sleep hours not reported
Bartel et al 2004 South Africa[34]	RCT	33 participants	Testing using Stanford Sleepiness Scale after night duty and 24 hours after duty	24-Hour shifts resulted in a >15% reduction in response speed on a single task	Small sample size Tasks were only of short duration
Chow et al 2005 Hong Kong[50]	Descriptive	104 medical residents	Voluntarily submitted near-miss reports	Half the lab near-misses occurred when working between 12 and 20 hours	Showed significant differences based on experience Sleep hours not reported
Frey et al 2002 United States[33]	RCT	11 medical residents	Electroencephalography and psychometric tests after 24 hours on duty with and without a nap	After 16-hour shift, performance did not decrease further with extended shifts	Small sample size Standardization of testing may not represent real-world experiences
Fruchtman et al 2011 Israel[37]	Descriptive	76 medical residents	Questionnaires on personal lives and fatigue	After 24-hour shift 29.3% of residents reported falling asleep while driving, and 13.9% had been in an accident	Subjective data Hours slept not reported
Landrigan et al 2004 United States[28]	RCT	5888 medical resident-to-patient contact hours	Evaluation of medical errors with traditional schedule and eliminating extended-duration shifts	24-hour shifts had 36% more errors than 15- to 16-hour shifts (100.1 errors/1000 patient-days)	Effect of elimination of 24-hour shifts and shift coverage and patient safety was not considered Single-blinded
Lockley et al 2004 United States[47]	Correlational	20 medical residents	Sleep diaries when working night shifts had a 50% reduction in the rate of attention failures from 24-hour shifts ($P = .07$)	When working 16-hour traditional schedule vs 16-hour schedule	Small sample size Subjective data collection, objectively validated
Mautone 2009 United States[23]	Correlational	64 medical residents	Elimination of 24-hour call to 14-hour shifts and reported MVAs	Decreased MVAs in 14-hour shifts	Subjective data Hours slept not reported
Powell et al 2001 United States[29]	RCT	16 adult participants	Evaluation of acute and chronic sleep deprivation with blood alcohol content	Acute sleep deprivation of 24 hours equivalent to blood alcohol content of 0.089%	Small sample size Data from general public, not medical professionals

Continued

Table 5. Studies Addressing Effects of Sleep on Safety

Source	Study Design	Participants	Methods	Study Outcomes	Comments
Rothschild et al 2009 United States[32]	Correlational	220 physicians	Retrospective rates of complications from procedures after 24-hour shifts	When working <18 hours, physician errors were 3.2%; >18 hours, errors doubled to 6.2%	Sleep hours not reported Focused on obstetrics and gynecology procedures
Scott et al 2007 United States[36]	Descriptive	895 RNs	Logbooks on work hours, sleep duration and drowsiness	When working <8.5 hours, 15.7% of MVAs occurred; in shifts >12.5 hours MVAs doubled to 31.3%	Randomized sample Self-reported data Relied on memory recall No distinction between near-miss MVAs and MVAs
Surani et al 2007 United States[49]	Correlational	16 medical residents	Comparison of sleepiness while driving on night-float residents and non-post-call residents	87.5% of residents reported falling asleep while driving	Small sample size Subjective data collection
Trinkoff et al 2007 United States[30]	Descriptive/ longitudinal	80 RNs	Sleep, sleepiness, and fatigue after 12-hour shifts	Increased risk of needle sticks when working 13 hours or more (OR, 1.68)	Some injuries due to equipment failure, not sleep hours Self-reported data Longitudinal design

Abbreviations: MVA, motor vehicle accident; RCT, randomized clinical trial; RNs, registered nurses.

however, this may be more difficult because of other educational activities. The authors recognize that in practice, midwives can be on-call for long durations. Students' learning proper preparation for extended shifts may be valuable; however, the research shows that the risk of sleep deprivation does not outweigh this benefit. Additional research on shift duration for practicing midwives is important for improving safety for patients and practitioners.

Although practicing midwives may be on-call for extended durations, they may only be on duty while patients are in labor (Table 1). It is appropriate for students to remain on-call with preceptors to maximize the birth and learning experiences provided during clinical hours; however, duty shifts and continuous working time should be limited for students to improve learning and increase safety. Research has shown that when residents are on-call for 24 hours, sleep duration ranges from 0 to 4 hours, with the average a maximum of 2.09 hours of consecutive sleep,[7] far less than the recommendation of 7 to 9 hours of sleep per night by the National Sleep Foundation.[1] Once shifts were decreased from 24 to 16 hours, reported sleep increased to 5.8 hours per night when on-call.[28] However, for optimal cognitive and physical performance, as well as improvements in quality of life and safety, research supports the adoption of limitations of 12-consecutive-hour shifts.

This review of the literature is limited by the lack of research on the impact of shift length on midwives and SNMs/SMs. Although SNMs/SMs function in a different capacity than medical students/residents, comparisons between medical residents and SNMs/SMs may be similar based on curriculum, mandatory practicum hours, and nature of patient contact. For the purposes of this review, data were evaluated from studies on medical residents and practicing RNs because of the lack of research on sleep and midwifery or other similar advanced practice nursing fields. The authors recognize that the work schedules and demands on SNMs/SMs are different from medical residents and practicing nurses. Shorter duty shifts for SNMs/SMs may pose challenges to scheduling enough clinical practice hours, particularly in smaller-volume practices. The value placed on continuity of care can lead students and practitioners to work past reasonable limits on work shifts. Nevertheless, the available data on cognition, performance, and safety make a strong argument for limiting on-duty hours for students. Beyond the immediate benefits while in school, such a strategy reinforces the importance of adequate sleep for professional practice after graduation.

Further research is needed to determine the ideal duty-shift length for student midwives and SNMs/SMs. Although it is expected that graduate education limits the sleep of students, very little is known about the actual sleep experience of SNMs/SMs and how this affects their education. Furthermore, the impact of restorative naps during extended-duty shifts is unknown. Lastly, optimal work patterns for midwifery practices may differ according to the number of practitioners in the group. Research studies that examine these topics would be useful in the future for evaluating current shift length, as well as for future improvements.

Table 6. Examples of Organizational Policies on Duty Shifts

Organization	Policy
Accreditation Council for Graduate Medical Education (ACGME), 2003[3]	Maximum 80 hours per week (averaged over 4 weeks)
	Maximum 24-hour shifts, with an additional period up to 6 hours for continuity of care and educational activities
	Moonlighting counts toward the weekly limit
	In the emergency department, maximum 12 consecutive hours worked, with equivalent period of time off between shifts; maximum 60 hours per week with an additional 12 hours for educational activities
Association of periOperative Registered Nurses (AORN), 2011[43]	Maximum 12 consecutive hours worked in 24-hour period
	Maximum of 60 hours per week
	Sufficient transition time for appropriate patient hand-off
	Allow off-duty hours for 8 hours uninterrupted sleep
	Consideration of individual abilities when scheduling on-call shifts
	Ethical responsibility of RN to arrive at work adequately rested and prepared for duty
European Union European Working Time Directive (WTD), 2009[6]	Maximum 48 hours per week (averaged over 17 weeks)
	Minimum rest period 11 hours after a shift
	Minimum 24-28 consecutive hours rest per week (averaged over 14 days)
	Shift rest 20 minutes during any work period >6 hours
	Free health assessments for nighttime workers
	Paid annual leave minimum 4 weeks
Institute of Medicine (IOM), 2008[4]	Maximum 80 hours per week (averaged over 4 weeks)
	Maximum 30-hour shift (16 hours admitting patients, 5 hours protected sleep between 10 PM and 8 AM, and an additional 9 hours for transitional and educational activities)
	Maximum on-call every third night
	Minimum rest period 10 hours after a day shift, 12 hours after a night shift, and 14 hours after any extended-duty shift or 30 hours (not to return until 6 AM the next day)
	Maximum 4 consecutive nights in-hospital, with 48 consecutive hours rest after
	Minimum 24 hours consecutive rest per week and one 48-hour period per month (total 5 days)
	Moonlighting counts toward weekly limit
	In the emergency department, maximum 12 consecutive hours worked, with equivalent period off between shifts; maximum 60 hours per week, with an additional 12 hours for educational activities
National Academy of Sciences (NAS), 2004[5]	Maximum 12 consecutive hours worked per 24-hour period
	Maximum 60 hours per week
National Association of Neonatal Nurses (NANN), 2011[51]	Promote a culture that recognizes nurse fatigue as an unacceptable risk
	Schedule sensibly
	Maximum 12 consecutive hours worked per 24-hour period
	Allow off -duty hours for 8 hours uninterrupted sleep
	Permanent shift assignments, avoiding rotating shifts
Student National Medical Association (SNMA), 2003[38]	Maximum 80 hours per week (averaged over 2 weeks)
	Maximum 24-hour shifts
	Maximum on-call every third night (averaged over 2 weeks)
	Minimum 24 hours consecutive rest per week (averaged over 2 weeks)
	Protection to residents who report violating programs
	Civil penalties and public disclosure of violating hospital programs

Abbreviation: RN, registered nurse.

CONCLUSION

Quality and length of sleep have proven to be critical in learning, cognition, and physical performance. The period of learning in clinical rotations in student midwifery education provides the foundation for expertise in practice and transformation into proficiency.[41] Creating a culture of safety that promotes learning and quality of life while advocating for safety is necessary within the midwifery community. To meet these important goals, professional organizations and education institutions should develop clinical hour limitations for SNMs/SMs while maintaining the relationships between the SNM/SM and the patient during the unpredictable birth process. These recommendations may include limiting consecutive on-call hours per day and total on-call time per week. Such policies may consider extensions of duty hours for observation for continuity of care or educational activities. Because many students may work to pay for their education, these recommendations may need to account for hours of paid work in the total hours allowed. These limitations should encourage consistent nocturnal sleep to allow SNMs/SMs to obtain the necessary experiences and knowledge base for entry into practice while increasing patient and student safety, student quality of life, and advancement of learner abilities from novice to expert. In addition, students must take professional and ethical responsibility for their sleep duration before and after duty. This may include arriving for clinical shifts well rested, optimizing restorative rest breaks and naps during extended-duty shifts when appropriate, and only driving home when sufficiently rested and alert. Risks for errors for patients and SNMs/SMs cannot be eliminated completely, but minimizing the risks is possible by adopting duty-hour recommendations.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose

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