Received: 2 June 2023 | Revised: 31 August 2023 | Accepted: 2 October 2023

DOI: 10.1111/jocn.16912

SCOPING REVIEW

Journal of Clinical Nursing WILEY

Sleep deprivation and medication administration errors in registered nurses—A scoping review

Christopher Vincent Martin RN, BSc, GradDip, Senior Lecturer[1,2] | Joanne Joyce-McCoach PhD, Academic Program Director[1] | Monica Peddle PhD, SFHEA, Associate Professor, Director of Simulation Education[3] | Christine Elizabeth East PhD, Professor of Nursing and Midwifery, Director of Graduate Research[4,5]

[1]School of Nursing and Midwifery, La Trobe University, Bundoora, Victoria, Australia

[2]School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Ballarat, Victoria, Australia

[3]School of Nursing and Midwifery, Deakin University, Burwood, Victoria, Australia

[4]Judith Lumley Centre, School of Nursing and Midwifery, La Trobe University, Bundoora, Victoria, Australia

[5]Mercy Health, Melbourne, Victoria, Australia

Correspondence

Christopher Vincent Martin, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, ACU, Ballarat Campus, 1200 Mair Street, Ballarat, VIC 3350, Australia.
Email: christopher.martin@latrobe.edu.au and christopher.martin@acu.edu.au

Abstract

Aim: To explore whether sleep deprivation contributes to medication errors in registered nurses (RNs).

Background: Sleep deprivation is a potential issue for RNs, particularly those who work shifts. Sleep deprivation has been found to have a negative impact on numerous cognitive processes. Nurses administer several medications to patients a day, potentially while sleep deprived—anecdotal reports suggest that this could result in an increased risk of error occurring.

Design: A scoping review was conducted using the Prisma-ScR extension framework to explore what is known about the effect of RNs' sleep deprivation on medication administration errors.

Methods: A search of databases generated 171 results. When inclusion and exclusion criteria were applied, 18 empirical studies were analysed. Studies included retrospective analysis of errors, surveys of perceptions of causes and observational studies.

Results: Data indicated that RNs consider fatigue, which may be caused by sleep deprivation, to be a contributing factor to medication errors. The search only identified three observer studies, which provided conflicting results as to whether lack of sleep contributes to the error rate. Of the numerous tools used to measure sleep, the Pittsburgh Sleep Quality Index was the most frequently used.

Conclusion: Although RNs anecdotally consider a lack of sleep potentially contributes to medication errors, there is insufficient research to provide robust evidence to confirm this assumption.

No Patient or Public Contributions: Patient or public contributions were not required for this scoping review.

Relevance to Clinical Practice: Sleep deprivation is a potential issue for nurses, especially those who work shifts. Poor sleep impacts cognitive processes that potentially could increase errors. Nurses should be aware of the impact sleep may have on patient safety.

KEYWORDS
drug error, fatigue, human factors, medication error, registered nurse, sleep deprivation

1 | INTRODUCTION

Most clinical areas that a registered nurse (RN) may work in require them to administer medications—often several at once, via various routes, to multiple patients. They act as a bridge between physicians, pharmacists and patients, employing clinical expertise to ensure accurate and safe medication practices. Within the healthcare setting, several steps are involved before the patient takes the drug: starting with the decision to treat, through to prescribing, dispensing, transporting, storing and finally administering. In many ways, nurses can be considered the last line of defence, the final step in the process of treating a person with a therapeutic drug. Along with prescribing, the administration step is when most errors occur (Keers et al., 2013). It is at this point where an RN's alertness and concentration to identify and prevent a potential error and subsequent harm to the patient needs to be at its peak.

The rate of medication administration error has been widely researched, and estimated error rates in hospitals range between 5% and 19% (Keers et al., 2013; Roughead et al., 2016). However, the accuracy of these rates depends on the error being reported; factors such as time constraints, fear of blame and repercussions may mean there is a reluctance to report (Hammoudi et al., 2018); therefore, the estimated error rate may be higher than reported.

Most RNs within Australia work in the hospital setting (Department of Health, 2019), and the nature of this work requires 24-h care, meaning RNs will generally work shifts. Short periods of time between shifts and frequently changing schedules, such as a mix of morning, afternoon and night shifts within the same week, can result in an RN having trouble getting to sleep, poor sleep quality and difficulty staying asleep (Di Simone et al., 2020). These sleep disturbances potentially place RNs at risk of insufficient sleep that could result in temporary deterioration of attention, cognition, multitasking, response times and short-term recall of working memory (Durmer & Dinges, 2005; Lowe et al., 2017)—all attributes that are required when administering medication. The United States Nurses' Health Study (Patel et al., 2004) found that 30% of the study participants slept for 6 h or less. RNs were also more likely to have less sleep the night before a shift compared with the night before a non-workday (Stimpfel et al., 2020). This contrasts with the American Academy of Sleep Medicine's (Watson et al., 2015) recommendation that individuals should regularly sleep for 7 h or more per night. They go on to state that sleeping for less than the recommended amount of time is associated with impaired performance and increased errors. Elmenhorst et al. (2007) researched the impact of 5 h of sleep for four consecutive nights and found the impact on cognitive performance similar to that of a blood alcohol content of .06% (60 mg/dL)—a level at which driving a motor vehicle is generally illegal. While this may seem to at the extreme end of the spectrum, it is not unknown for this level of sleep to occur in RNs, particularly when working the night shift (Zverev & Misiri, 2009).

What does this paper contribute to the wider global community?

Medication errors are multifactorial; however, nurses frequently perceive poor sleep as a causative factor. Empirical evidence regarding the impact of registered nurses sleep and its relationship to drug errors is lacking.

Sleep regulation is controlled by two processes: the 24-h circadian rhythm (process C) and the homeostatic process (process S), and these two processes are thought to interact and influence quality, quantity and duration of sleep, which subsequently influences alertness and performance during the day (Borbély et al., 2016). The circadian (occurring over a 24-h period) pacemaker, which resides in the suprachiasmatic nuclei within the hypothalamus, dictates many aspects of human's sleep cycle, including patterns of sleepiness. This circadian rhythm increases the desire to sleep at night and wake in the morning, whereas the homeostatic process results in an increased desire to sleep the longer a person stays awake, this can be thought of as 'sleep pressure' which builds while awake and reduces as they sleep (Centre for Disease Control and Prevention, 2020). Misalignment of the circadian rhythm, and the build-up of sleep pressure, occurs in shift workers (particularly night shift workers), and the process of returning to synchrony may take several days (Boivin & Boudreau, 2014). Individual RNs vary in their tolerance to shift work, with respect to circadian and sleep disturbance (Axelsson et al., 2004), and even in the absence of shift rotation, only 3% of night shift workers are thought to show complete circadian rhythm adjustment (Folkard, 2008). RNs that do suffer daytime sleepiness, poor sleep and longer recovery following shift work are said to suffer from shift work disorder (Booker et al., 2018), and up to a third of RNs may be affected by this (Flo et al., 2012). Ultimately, these sleep deficits can cause both acute and chronic sleepiness, which may impact alertness and performance (Lim & Dinges, 2010), and may have a flow on effect for the occurrence of medication errors. The actual term sleep deprivation can be broadly considered insufficient sleep, and as found by Asfour et al. (2014) difficult to define, with the definition varying widely amongst studies.

Within Australia, the National Safety and Quality Health Service Standards (Australian Commission on Safety and Quality in Health Care, 2017) inform consumers of the level of care they can expect from health service organisations. Improvements in patient safety are important, and medication errors constitute a large percentage of errors that do lead to patient harm. Therefore, identification of contributing factors to medication errors, such as sleep deprivation, have the potential to make an important difference to medication management and in turn patient safety. Therefore, this scoping review focuses on the potential effect of sleep deprivation on medication administration errors made by RNs. Additionally, while this review focuses on medication errors, studies that used fatigue tools which included sleep duration have been included as they often have a component that considers sleep.

2 | RESEARCH QUESTION AND OBJECTIVE

The research question is as follows: 'Does sleep deprivation contribute to medication administration errors in Registered Nurses?' The objectives of this review are to: (i) explore what is currently known about sleep deprivation and medication errors; (ii) map how research has been conducted; and (iii) ascertain if gaps exist in the research literature.

3 | METHODS

A scoping review was chosen to ensure a comprehensive overview and synthesis of the current literature, map key concepts and explore gaps in the research relating to this topic (Colquhoun et al., 2014; Peters et al., 2015), allowing for a broad analysis of studies rather than focussing exclusively on study rigour as is the case with a systematic review. Several studies have focussed on medication error and fatigue while not having sleep deprivation as their primary outcome measure, thus keeping the search broad decreased the likelihood of overlooking relevant information. The preferred reporting items for systematic reviews and meta-analysis extension for scoping reviews (Data S1) were used as a framework for reporting (Tricco et al., 2018).

3.1 | Inclusion and exclusion criteria

In 2000, the seminal report 'To Err is Human: Building a Safer Health System', initiated by the United States Institute of Medicine, was published (Kohn et al., 2000). This report raised the issue of improving patient safety within hospitals through safer health systems and highlighted the human factors that may be associated with patient safety; therefore, studies post 2000 which met the inclusion criteria in Table 1 were included.

Empirical research studies that investigated medication error, perception of cause or near miss errors relating to administration were included (Table 1). Errors occurring by any route (oral, intravenous, intramuscular, subcutaneous, etc.) were considered. Medication prescription errors were excluded, as this is a procedure that requires registration as a nurse practitioner or medical officer. The process of administering medication is a commonly occurring procedure and usually follows a similar process regardless of location, that is a prescription relating to a patient is added to a paper-based or electronic drug chart.

Studies that analysed medication error in RNs were included. The definition of an RN, for the purposes of this review, includes nurses that have completed a 3-year (minimum) bachelor's degree that has led to registration with the relevant governing body of that state or country as a RN. Other healthcare professionals (including diploma trained, enrolled nurses and licensed practical nurses) were excluded due to the difference in length, content and focus on medication during their degree or diploma.

Obstructive sleep apnoea has been shown to affect memory, executive function and attention (Bucks et al., 2013), which potentially could affect the RN ability to perform medication administration safely. Therefore, studies that included participants with a sleep disorder, such as obstructive sleep apnoea, were excluded to reduce confounding effects.

3.2 | Process for identifying terms

Key words were selected in collaboration with an information scientist (librarian). These were piloted, and refinements were made based on the generated results. All authors discussed and agreed upon the final search terms.

A search of two databases was conducted: MEDLINE generated 55 articles while CINAHL generated 116 articles (Table 2). These databases were used as they generated studies that were most relevant to the nursing profession. Initially, the PUBMED database was also searched; however, this generated more than 2000 results.

TABLE 1 Inclusion and exclusion table.

Inclusion	Exclusion
Published in the English language. Primary research (qualitative, quantitative or mixed methods) published from 2000 onwards and available in full text. Literature relating to medication administration error in registered nurses (RNs) with fatigue/sleep deprivation as a contributing factor. Occurring in hospital, residential facility or community setting.	Published in languages other than English. Literature earlier than 2000. Literature reviews, commentaries, book reviews, unpublished abstracts. Literature relating to compassion fatigue. Literature involving disciplines other than RNs. Literature relating to fatigue/sleep deprivation in patients. Studies that include nurses that have a diagnosed sleep disorder. Literature relating to sleep deprivation and disease. Studies involving animals.

Many irrelevant as they did not relate to health. For this reason and due to the unwieldy number of articles, PUBMED was excluded from the final search. Reference lists during the full-text screening were also reviewed. When duplicates were removed, 141 articles were selected for title and abstract review. The final search occurred during February 2022.

3.3 | Study selection

The web-based collaboration software platform 'Covidence' (Covidence Systematic Review Software, 2021) was used to ensure efficiency and accurate record keeping. The initial database search was conducted by author 1, and following duplicate removal yielded 141 studies (Figure 1). Author 1 and 4 assessed the titles and abstracts of these articles, applying predefined inclusion and exclusion criteria to determine their alignment with the scoping review and progression to the full-text review. Any disagreements between the reviewers were resolved through discussion with all authors until a consensus was reached. Thirty-four studies underwent a full-text evaluation by all authors, a review of reference list by title was conducted by author 1, which did not generate any further studies. The same process used to resolve disputes during the study title and abstract selection was also used for full-text analysis disputes.

TABLE 2 Search strategy.

Search terms
sleep deprivation OR fatigue* OR tired* OR shift work*
AND
medication error* OR medication incident* OR medication administration OR drug error*
AND
health care professional* OR nurse* OR registered nurse* OR RN

3.4 | Data extraction

The initial extraction document was designed by author 1 and reviewed by all authors. A pilot of the extraction tool was undertaken using two studies. Following this, the extraction document was further refined and reviewed by all authors, and a final version was agreed upon. The data extraction process was completed by author 1 and reviewed by all authors. Data from each of the studies selected for final review were charted using the following headings: author, year, country, key words, aim, methodology, sample size, data analysis and outcome related to research question.

4 | RESULTS

The number of studies identified for inclusion in the review was 171. Following removal of duplicates, a total of 141 papers were screened by title and abstract based on inclusion and exclusion criteria. Following this process, 34 studies remained for full-text analysis, 16 were excluded at this stage as they combined RNs with other health

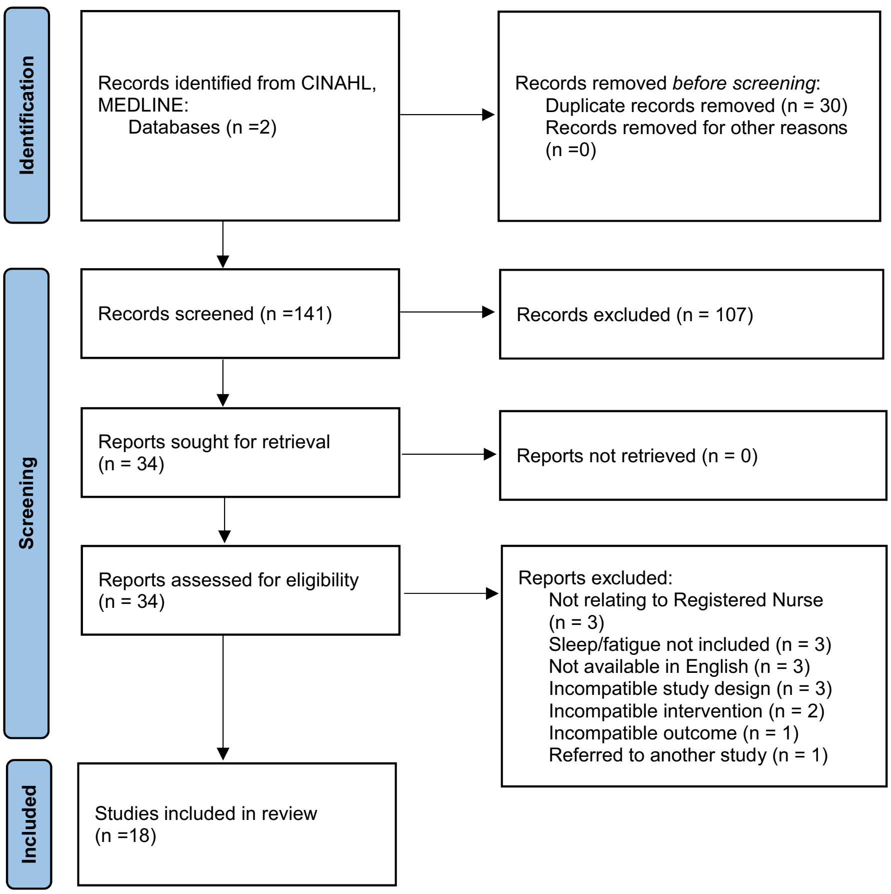

FIGURE 1 Identification of studies via databases and registers (Page et al., 2021). [Colour figure can be viewed at wileyonlinelibrary.com]

disciplines and did not differentiate the results between them (n = 3); were not available in English (n = 3); did not include sleep or fatigue in the study (n = 3); used an incompatible study design (n = 3); had an outcome or intervention that did not relate to the scoping review (n = 3); or referred to another study (n = 1). A total of 18 studies were included in the final review (Figure 1). The data are summarised in Table 3.

4.1 | Study characteristics

Studies were conducted across 11 countries, most commonly being the United States of America (n = 4) (Bellebaum, 2008; Morelock, 2014; Scott et al., 2006; Thomas et al., 2017), and Iran (n = 4) (Abdar et al., 2014; Bolandianbafghi et al., 2017; Fathi et al., 2017; Gorgich et al., 2016), Japan (n = 2) (Seki & Yamazaki, 2006; Suzuki et al., 2005), followed by Thailand (Chaiard et al., 2018), India (Chalasani & Ramesh, 2017), Australia (Deans, 2005), Italy (Di Simone et al., 2020), Finland (Härkänen et al., 2018), UK (Haw et al., 2005), Ireland (Murphy & While, 2012) and Canada (Parshuram et al., 2008) (n = 1). A quantitative approach was used in 12 studies and a mix of quantitative and qualitative in six studies. Studies using questionnaires were frequently seen (n = 12) (Abdar et al., 2014; Bolandianbafghi et al., 2017; Chaiard et al., 2018; Deans, 2005; Di Simone et al., 2020; Fathi et al., 2017; Gorgich et al., 2016; Morelock, 2014; Murphy & While, 2012; Scott et al., 2006; Seki & Yamazaki, 2006; Suzuki et al., 2005), these varied between web based or paper based. Reviewing medication error and recording fatigue/sleep deprivation took place over lengths of time varying from 6 months to 2 weeks. Retrospective analysis of incident reports or retrospective self-reported medication error was infrequently used (n = 2) (Härkänen et al., 2018; Haw et al., 2005). Two studies involved direct observation of the RN dispensing administering medications to a patient (Bellebaum, 2008; Thomas et al., 2017). Direct observation in a simulated environment (n = 1) (Parshuram et al., 2008) took place using Intravenous drug preparation only.

The following categories were derived from the included studies: Conflicting results are apparent when considering whether a relationship exists between sleep and medication error; the instrument used to measure medication error and sleep or fatigue was not consistent across studies; when asked (either by survey or via incident reports), RNs considered fatigue (which may have been caused by a lack of sleep) contributed to medication administration errors; no randomised controlled trials have been conducted on the topic, and few observer studies have been undertaken.

4.2 | Influence of sleep on medication errors

Occupational errors, including medication administration errors, were more common in participants who had a sleep duration of less than 7 h and was found to be linked to an increase in medication errors as noted by Chaiard et al. (2018). Similar results were found by Parshuram et al. (2008), who noted that a larger magnitude of errors was found in RNs who had slept fewer hours the night prior to the study. This finding was also supported by Di Simone et al. (2020), who noted a relationship between an increased risk of error and disturbed sleep, and Suzuki et al. (2005) who noted an association between excessive daytime sleepiness and medication error. However, Chaiard et al. (2018) found that while errors were more common in RNs with less sleep, the overall results were not significant and sleep duration did not increase the risk of occupational errors.

Fathi et al. (2017) noted that fatigue caused by excessive work was the most common cause of error, and Chalasani and Ramesh (2017) and Abdar et al. (2014) the second most common. Deans (2005) considered fatigue and lack of sleep together and found that these human factors contributed to 16% of the errors. This approach was also taken by Murphy and While (2012), who found a relationship between fatigue/lack of sleep and medication error. Morelock (2014) also found an association between fatigue, sleep quality and errors. Thomas et al. (2017) observational study included fatigue as a potential distraction. They found that it was the second most common self-reported distraction of RNs after unresolved issues regarding other patients; however, no relationship was found between fatigue and medication errors. This was also the case for Bellebaum (2008) and Bolandianbafghi et al. (2017), who found no relationship between fatigue and error.

Scott et al. (2006) found that a longer shift duration increased the risk of both error and near miss, and that the risk of falling asleep at work doubled when working more than 8 h. Whereas Seki and Yamazaki (2006) considered fatigue and near miss errors, in contrast to actual errors, and found that RNs with a lower level of fatigue prior to their shift had a higher number of near miss episodes.

Härkänen et al. (2018) reviewed incident reports and noted that tiredness contributed to errors, and this was often attributed to either shift work or self-reported lack of sleep. Similarly, Haw et al. (2005) also reviewed incident reports and found that personal factors, such as feeling tired, contributed to medication errors. Gorgich et al. (2016) also found this to be the case; however, this study only considered tiredness due to an increased workload rather than due to a lack of sleep.

Studies that considered night shift and medication error (n = 4) found that night shift was a contributing factor (n = 3) (Abdar et al., 2014; Di Simone et al., 2020; Härkänen et al., 2018). Conversely, Morelock (2014) did not find a significant effect when comparing day and night shift and errors, though they note a small sample size may have influenced these findings.

4.3 | Measurement of sleep

Eleven studies used one or more tools to measure either sleep or fatigue. The Pittsburgh Sleep Quality Index (PSQI) was the most frequently used to assess sleep (Di Simone et al., 2020; Morelock, 2014; Suzuki et al., 2005). Sleep diaries featured as a tool for measuring sleep duration in two studies; Chaiard et al. (2018) measured over 1 week, whereas Scott et al. (2006) measured over 28 days. Two

TABLE 3 Results of the review.

Aim	Methodology	Location/sample
Abdar et al. (2014)		
Determine RN perception of the cause of medication errors	Qualitative Cross-sectional survey	Iran Survey completion $n=239$
Bellebaum (2008)		
To determine the relationship between nurses' work hours and the occurrence of ME. To determine the relationship between fatigue and the occurrence of ME	Non-blinded direct observational study performed in a hospital setting	USA Medication administration events observed $n=548$
Bolandianbafghi et al. (2017)		
Determine the correlation between the amount and type of medication error with job satisfaction and fatigue of nurses	Descriptive correlational cross-sectional study across four hospitals	Iran Survey completion $n=170$
Chaiard et al. (2018)		
To explore the influence of sleep duration on fatigue, daytime sleepiness and occupational errors	Quantitative, cross-sectional self-reported error questionnaire, utilising a 1-week sleep diary. Two groups <7 h sleep and ≥7 h sleep	Thailand Questionnaire completed $n=233$
Chalasani and Ramesh (2017)		
To determine the incidence, cause, patterns and outcomes of medication error in an intensive care unit	An open, anonymous prospective medication error reporting system was reviewed	India Reported medication errors $n=292$ Error reported by nurses $n=122$
Deans (2005)		
To identify and describe the incidence, type and causes of ME—and the impact on professional practice	Single site anonymous self-report survey: medication error questionnaire (MEQ)	Australia Surveys completed $n=79$
Di Simone et al. (2020)		
To evaluate quality of sleep and self-perception of risk of medication error	Cross-sectional questionnaire about quality of self-perceived quality of sleep and the risk of ME. Risk of error based on near miss events	Italy Questionnaires completed $n=446$
Fathi et al. (2017)		
To examination the prevalence, types of medication errors and barriers to reporting	Quantitative, multisite cross-sectional questionnaire to assess the prevalence and RN perception of the main causes of medication error over a 3-month period	Iran Questionnaires completed $n=500$
Gorgich et al. (2016)		
To investigate the causes of ME and strategies to prevent them	Cross-sectional descriptive study to investigate the cause of ME and preventative strategies	Iran Questionnaires completed $n=327$

Data collection/instrument	Data analysis	Outcome
Iranian nurses' medication errors questionnaire	Perceived effect fatigue had on ME: High: $n=168$ Moderate: $n=54$ Low: $n=13$ Without: $n=168$	Perceived most common cause of ME: staff/patient ratio; fatigue; illegible prescription; workload; nightshift
Checklist Individual Strength (CIS) chronic fatigue instrument—designed by Vercoulen et al. (1994) 11 item need for recovery acute fatigue instrument. ME tool: American Society of Health Systems Pharmacists guidelines	Dose errors occurrence 6%	The study did not find a relationship between nurse fatigue and the occurrence of medication administration error
Medication errors questionnaire developed by Wakefield et al. (2005). Fatigue questionnaire scale designed by co-researcher	Fatigue 45.25 (SD 22.17) p-value .711 Injectable: female 25.48 (SD 22.83) male 26.90 (SD 25.54) p-value .194 Fatigue 45.25 (SD 22.17) p-value .819	The study found an increased incidence of fatigue in medication errors, but the increase was not found to be statistically significantly
Sleep: Adapted 1-week sleep diary (National sleep foundation). Fatigue: Fatigue questionnaire (Chalder et al. 1993), To assess daytime sleepiness: Thai version of Epworth sleepiness scale. To assess occupational errors: Researcher designed occupational error questionnaire	13 RNs (6.6%) made a medication error. 11 of these were from the short sleep group and 2 from the normal sleep group (p-value .069). Short sleep duration did not increase risk of fatigue (OR = 1.44, 95% CI = .66–3.12) or occupational errors (OR = 1.19, 95% CI = .22–6.33)	ME were more common RNs in the short sleep duration group, but this was not a result of significance
Inpatient case records were reviewed, ME based on NCC MERP	Medication administration errors comprised 35.9% of ME $n=105$ and were the most reported error. Contributing factors to ME (according to reporter): fatigue $n=41$	RN perception of contributory cause of ME: Workload was the most common for ME. Fatigue the second most
MEQ—researcher designed and based on NCC MERP	Contributed to ME: error, fatigue/lack of sleep $n=13$ (16.5%) Stress and high workload: $n=20$ (25.3%)	Several human factors were attributed to potential causes of medication error: a stressful workload, fatigue and lack of sleep
Sleep: PSQI Risk of medication error questionnaire designed by the authors based on '7 rights rule'	The risk of ME correlated with poor sleep quality, as measured by PSQI score >5 ($p<.01$). Risk of ME associated with short resting time after a night shift, and associated with a bad self-perception of quality of sleep (OR 3.165, 95% CI 1.468–6.827, $p<.01$	Shift work, disturbed sleep and risk of medication errors are tightly coupled
Researcher designed questionnaire including: 31 predefined potential causes for the medication error using a 5-point Likert scale. Nine yes/no questions regarding the type of medication error	Prevalence of a ME over a 3-month period was 17% (95% CI, 13.7 to 20.3%) Causes: Fatigue caused by excessive work hours: mean 3.94 (SD 1.02) Type of shift work: mean 3.74 (SD 1.05)	Based on 31 potential causes of ME, the RN listed fatigue caused by excessive work hours, and the type of shift work as the two factors that had the greatest degree of influence on ME
Researcher designed questionnaire, consisting of 22 predefined causes of ME which required a yes/no answer and ways of preventing ME from occurring	Causes of ME: Fatigue due to high workload: $n=320$ Critically ill patients $n=294$	The most common perceived cause of medication error was tiredness due to increased workload

(Continues)

TABLE 1 (Continued)

Aim	Methodology	Location/sample
Härkänen et al. (2018)		
To describe the factors pertaining to medication being administered to the wrong patient and to describe how patient identification is mentioned in incident reports	Mixed methods, descriptive content analysis. Incident reports over a 12-month period, that related to medication errors from two hospitals (university and central hospital) were reviewed	Finland Incident reports relating to ME reviewed $n=1012$
Haw et al. (2005)		
To assess the nature, frequency, potential severity and contributing factors to medication administration errors	Single site retrospective analysis of medication administration errors over a 3 ½ year period	UK ME reports reviewed $n=112$
Morelock (2014)		
To understand the relationship between critical care nurses' work environment, job satisfaction and nursing errors. And to examine the nursing environment to determine the risks of practicing during the night shift	Quantitative survey of high acuity nurses in critical care settings	USA RNs $n=45$
Murphy and While (2012)		
To investigate the medication administration practices of children's nurses. Perceived cause of medication errors	Nonexperimental anonymous survey design. Mix of quantitative and qualitative responses. Only paediatric nurses surveyed	Ireland Surveys completed $n=59$
Parshuram et al. (2008)		
An evaluation of steps in the infusion preparation process to identify factors associated with medication errors. Primary outcome: the occurrence of errors Secondary: number and magnitude of errors	Quantitative direct observational study in a simulated environment. Participants completed administration of intravenous drugs	Canada Participants $n=118$, of which RN = 81
Scott et al. (2006)		
To describe the work patterns of critical care nurses and determine if an association exists between the occurrence of errors and the hours worked, and whether these work hours have an adverse effect on nurses' vigilance	Descriptive, exploratory survey	USA Surveys completed $n=502$
Seki and Yamazaki (2006)		
To explore which working conditions influence the occurrence of medication errors related to intravenous medication	Quantitative self-report questionnaire analysing working conditions that can lead to near miss errors relating to Intravenous medication in RNs	Japan Questionnaires completed $n=88$
Suzuki et al. (2005)		
To determine the prevalence of excessive daytime sleepiness (EDS) and to analyse associations between EDS and different types of medical error	Cross-sectional study using a closed ended structured questionnaire	Japan Questionnaires completed $n=4279$

Data collection/instrument	Data analysis	Outcome
Analysis of incident reports including both a predefined list and free text. Prompting questions included: what happened, how it happened, circumstances and other factors that may have contributed to the incident	Of the 103 reviewed ME incident reports, contributing factors (self-reported by RN) were as follows: 'Nurse was tired ' $n=9$ 'Nurse was working night shift' $n=11$	Tiredness was quite often attributed to hard or long work shift: For example AM followed by PM, night shift or lack of sleep. The night shift was seen as a cause of errors
Review of incident report form including description of error and contributing factors	Personal factors contributed to errors in 19 instances. These included tiredness, poor concentration, inadequate supervision and lack of support	Two most common factors cited as contributing to error were busy noisy environment and personal factors (such as feeling tired or unsupported)
To measure attention, the Brief Fatigue Inventory (Mendoza et al., 1999). Sleep quality: PSQI To measure nurses' perceptions of risk: a 5-point Likert scale (not used previously)	Analysis: Spearman's rho (power .8). Outcome variables were self-reported errors. RNs identified how many errors they had made in the last 12 months. Correlations were found when comparing fatigue and errors (rs = .48 $p=.001$)	Fatigue was positively associated with errors
Author designed survey consisting of five sections: Medication administration practices, reporting errors, causes of medication errors, individual practice and administration, and demographics	Open-ended questions were reviewed for thematic analysis. 61% of participants indicated fatigue/lack of sleep was a cause of ME	Human factors such as workload stress and fatigue were considered a significant cause of medication errors
Errors were considered to have occurred if outside of industry standards, or 10% of expected concentration. Sleep duration based on self-report from participant	c2 test was used to compare individual characteristics (including number of hours sleep in the previous 24h). Larger magnitude errors were associated with fewer hours sleep in the previous 24h ($p<.001$) The mean sleep duration of RN in previous 24-h was 7.18 (SD 2.4)	Causes of errors include experience, background and fatigue
RN completed two 14-day logbooks (28-day total) documenting sleep habits and medication errors. Errors were based on participant self-reporting a perceived error	Univariate analysis. Primary outcome variable: occurrence or no occurrence of an error during the work shift. 224 errors and 350 near errors were reported. 27% made at least one error. 38% made a near error	The risk of making an error almost doubled when working more than 12.5 consecutive hours (odds ratio 1.94, $p=.03$). No association found between decreased vigilance (struggling to stay awake) and increased risk of errors
Fatigue was measured immediately before work using a 100mm fatigue visual analogue scale. 100 = severe fatigue and 0 = no fatigue. Sleep duration before work was recorded. Error: self-reported	Analysis: logistical regression Near miss errors were reported $n=94$ (17.9%) times. Sleep duration before work (hours): AM 6.1 ± 1.3 PM 8.5 ± 3.0 NS 3.1 ± 2.2	RNs whose level of fatigue before work during the AM shift experienced a higher frequency of near miss episodes than other nurses. Workers were less able to detect errors when their arousal levels are low
Sleep information gathered using the PSQI (Japanese version) Errors were included if they occurred in the previous 12 months—self-reported	ME without EDS $n=3081$ OR 1.00 (CI 1.04–1.37) With EDS $n=1080$ OR 1.19 Analysis: Wilcoxon rank-sum test	A relationship of significance was shown between ME and excessive daytime sleepiness

(Continues)

TABLE 1 (Continued)

Aim	Methodology	Location/sample
Thomas et al. (2017)		
To examine the relationship of interruptions and distractions (which includes fatigue) on cognitive load and medication errors	Quantitative, multisite, observational study.	USA RN participants $n = 79$ Medication administration episodes $n = 857$

Abbreviations: ME, medication error; NCC MERP, National Coordinating Council for Medication Error Reporting and Prevention; PSQI, Pittsburgh Sleep Quality Index; RN, registered nurse.

studies asked participants to state their sleep duration the night prior to the study (Parshuram et al., 2008; Seki & Yamazaki, 2006). Five studies used a form of fatigue instrument: Seki and Yamazaki (2006), in additional to establishing sleep duration, used a visual analogue scale (VAS) where fatigue was self-rated by the RN immediately prior to their shift. Bolandianbafghi et al. (2017) used a fatigue questionnaire designed by a co-researcher. In addition to the PSQI, Morelock (2014) also used the Brief Fatigue Inventory (Mendoza et al., 1999), a tool designed to assess fatigue in cancer patients. Whereas Bellebaum (2008) used a chronic fatigue instrument designed by Vercoulen et al. (1994), and Thomas et al. (2017) took a different approach by considering fatigue as a distraction measured with a VAS.

The period over which sleep duration was measured varied from the night prior, through to a 28-day period prior to the study. When sleep duration was recorded, no studies compared short-term sleep deprivation with sleep deprivation over a longer period.

4.4 | Recording medication error

Various tools were used to record a medication error occurring. The most frequently used was a tool that was researcher designed ($n = 6$) (Chaiard et al., 2018; Di Simone et al., 2020; Fathi et al., 2017; Gorgich et al., 2016; Murphy & While, 2012; Thomas et al., 2017) followed by the RN self-reporting the error and using their own judgement as to what constituted an error ($n = 4$) (Morelock, 2014; Scott et al., 2006; Seki & Yamazaki, 2006; Suzuki et al., 2005). A review of incident reports ($n = 2$) (Härkänen et al., 2018; Haw et al., 2005) and tools based on the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) (1998) guidelines ($n = 2$) (Chalasani & Ramesh, 2017; Deans, 2005) were the next most frequently used, followed by the Iranian nurses' medication questionnaire ($n = 1$) (Abdar et al., 2014), American society of health system pharmacist guidelines ($n = 1$) (Bellebaum, 2008), Wakefield et al. (2005) medication error questionnaire ($n = 1$) (Bolandianbafghi et al., 2017) and a tool that considered a variation of 10% from intravenous industry standards to be an error ($n = 1$) (Parshuram et al., 2008).

4.5 | RN perception of cause of error

All of the studies that collected data on what the RN perceives as a contributing factor toward medication errors noted the cause of medication error (rather than perceived or actual fatigue and/or sleep deprivation) included fatigue or sleep deprivation as a contributory factor. This was collected via survey ($n = 5$) (Abdar et al., 2014; Deans, 2005; Fathi et al., 2017; Gorgich et al., 2016; Murphy & While, 2012), analysis of incident reports or clinical notes ($n = 3$) (Chalasani & Ramesh, 2017; Härkänen et al., 2018; Haw et al., 2005), and by studying the perceived cause, which was self-reported by the RN following observation ($n = 1$) (Thomas et al., 2017). When a quantitative comparison was made with other factors, two studies found lack of sleep and/or fatigue was the most frequent cause of error (Fathi et al., 2017; Gorgich et al., 2016). A further seven studies found lack of sleep and/or fatigue to be within the top three causes of error (Abdar et al., 2014; Chalasani & Ramesh, 2017; Deans, 2005; Di Simone et al., 2020; Härkänen et al., 2018; Haw et al., 2005; Thomas et al., 2017).

4.6 | Observational studies considering the relationship between sleep duration and medication error

Three observational studies were included in the review: (Bellebaum, 2008) used a non-blinded observational study technique and observed RNs in a ward-based environment as they administered drugs to patients. They measured acute and chronic fatigue—no relationship was found between fatigue and medication error. Parshuram et al. (2008) conducted an observational study in a simulated environment using intravenous medication. The RNs that participated were asked how long they had sleep for the night prior to participating in the study. This study found that a larger magnitude of errors occurred in participants with fewer hours of sleep in the 24h prior to the study, which was measured by self-reported sleep duration. Thomas et al. (2017) performed a ward-based observational study and recorded the RNs level of distraction when an error occurred. In this case, fatigue (as a distraction) was the second most common cause of medication error; the most common was unresolved issues regarding other patients.

Data collection/instrument	Data analysis	Outcome
RN self-reported distractions during administration using a visual analogue scale. Observation sheet to record deviations from procedure	Outcome variables: Presence of one deviation in procedural step in medication administration and presence of at least 1 MAE in an episode. Episodes where fatigue as a distraction reported: 310 (36%)	No relationship was found between distractions (which included fatigue) and ME. Fatigue was the second most common self-reported distraction experienced by the RN

5 | DISCUSSION

The scoping review has identified that an answer to the research question remains elusive. While RNs consider that insufficient sleep, fatigue or tiredness contributes to medication errors, insufficient evidence, in the form of experimental, quasi-experimental or observational studies exists. Although studies have considered a relationship between sleep and performance in health (Philibert, 2005; Saadat et al., 2015; Weinger & Ancoli-Israel, 2002), there are gaps in the literature regarding studies that look for a specific relationship between sleep duration and the medication error rate in RNs.

RNs appear less able to detect errors when their sleep duration is reduced (Seki & Yamazaki, 2006), so conversely, an adequate amount of sleep prior to attending work may result in the detection of errors before they occur. Decreasing levels of performance do not always match self-perceived sleepiness (Van Dongen et al., 2004) so subjective reports of how sleepy a person feels may not be the most reliable measurement tool. Polysomnography is the most sophisticated means of measuring sleep (Kryger et al., 2017; Morgenthaler et al., 2007); however, this technique was not used in any of the studies. This is possibly due to cost and impracticality of the technique, where participants may be required to attend a sleep laboratory, remain overnight and be observed by technical staff, possibly over several days. The time, cost and commitment from participants and researchers would make it impractical for most studies. Therefore, it is unsurprising that all the studies used some form of self-reporting because it is cost effective and practical.

Self-recording of sleep was often used during studies, the most being the PSQI. This is expected as it is a commonly used tool to assess sleep quality in both the clinical and non-clinical environments, and there is strong positive evidence for both reliability and validity (Mollayeva et al., 2015). It focusses predominately on sleep *quality* but also measures quantitative aspects of sleep, such as time to bed, time to rise, time taken to fall asleep and total time asleep. To our knowledge, no studies have been conducted that use wearable technology to measure sleep duration in RNs. The use of actigraphy, such as wearable smart watches, is cost effective, accurate and minimises user burden. Wearable technology also allows for larger data sets than traditional measurement techniques and can increase understanding of sleep (Khosla et al., 2018; Perez-Pozuelo et al., 2020), and may be an option in place of self-recording of sleep duration.

Differentiation between sleep deprivation prior to a shift compared to a longer period of time was rarely a focus of studies, and both types are possible consequences of shift work. While the duration of time that sleep was measured varied, reasons for choosing this timeframe were not always elucidated. Regardless, both types of sleep deprivation can impact performance (Belenky et al., 2003; Mollicone et al., 2008). Future studies may benefit from an approach that considers and compares the impact of both chronic and acute sleep deprivation.

The terms fatigue, sleep duration, tiredness, fatigue due to excessive work and sleepiness were used within the studies. Sometimes, these terms were used interchangeably, such as considering sleepiness and fatigue as the same. Only one study (Seki & Yamazaki, 2006) differentiated between fatigue and sleep duration, and no studies used the term sleep deprivation. The lack of clarity around these terms meant that sleep itself was often considered within the term fatigue or tiredness, rather than an independent factor.

A sleep duration time of less than 7 h is common in nurses and can result in dissatisfaction with sleep time (Liu et al., 2021); this may be due to short periods of rest between shifts which can reduce sleep duration and result in daytime sleepiness (Booker et al., 2018). The term 'shift work disorder', which can be caused by work hours that occur during normal sleep time, resulting in misalignment of an RNs circadian rhythm and their shift schedule (Cheng & Drake, 2019), can result in extreme tiredness and insomnia (Di Milia et al., 2013). Curiously, the term shift work disorder was not mentioned in any studies; it can be assessed based on criteria found in the International Classification of Sleep Disorders (Sateia, 2014), so could potentially be considered in future studies that relate to RNs and drug errors. So too could the impact of sleep deprivation on medication errors during night shifts, when RNs are working in an environment in opposition to their circadian rhythm. Individuals affected by shift work disorder may experience excessive sleepiness during the night, with a peak at the end of the night (Boivin & Boudreau, 2014). Of concern is that individuals are also a poor judge of the impact sleepiness on their performance, and during the night is when a mismatch between their subjective alertness and their actual objective performance is largest (Zhou et al., 2012). Further research in this area may foster strategies that lessen the risk of error occurring during or because of the nightshift, such as occurs in aviation (ICAO, 2015), and rail transport (Office of the National Rail Safelty Regulator (ONRSR), 2020).

Some studies used self-reporting of medication error or retrospective analysis of self-reported medication incidents. While a reasonable method to analyse reports of errors, self-reporting raises the question of how many errors were not reported. There may be several factors that influence reporting: what is considered an error, is it serious enough to report, will it impact the RN's position if they admit to an error? Rutledge et al. (2018) confirmed this to be the case when they found self-reporting of medication errors are liable to be under reported—this was usually due to fear of repercussions and the time-consuming impact of completing the necessary documentation following an error. Westbrook et al. (2015) found similar results, that is the reporting of errors is less than the actual errors that occur in clinical practice.

In addition to the reporting of medication errors, a definition of what constitutes an error was not consistently applied across studies. While the various tools used offered a structured approach for identifying and evaluating medication administration errors, the majority were researcher designed. By implementing a standardised instrument, healthcare organisations could establish a uniform tool for documenting and categorising errors, which may assist in accurate comparisons across different nursing units, facilities and even geographical locations.

6 | STRENGTHS AND LIMITATIONS

A structured search was conducted, and following data extraction, characteristics of current studies were elucidated.

This review only included studies that were reported in English and because of this some relevant studies may have been excluded. The inclusion of studies that related to RNs that had undertaken a degree ensured homogeneous study groups; however, this also resulted in the exclusion of studies that included diploma trained nurses, or where other healthcare disciplines were combined in the results.

7 | CONCLUSION

The consistent opinion of RNs within the review was that fatigue, which may be caused by insufficient sleep contributes to medication administration errors. However, the lack of sufficient observational studies, and no randomised controlled trials, makes confirming this finding challenging. Future research designs that consider sleep duration both the night prior and the week prior, and shift work disorder, may clarify the impact of sleep on medication errors.

8 | RELEVANCE TO CLINICAL PRACTICE

While recommendations exist regarding sleep duration, it is challenging to define an exact cut-off point between a person being sleep deprived or not—this may be because of the variability between individuals. Research that measures sleep over a continuum rather than defining someone as being in a sleep deprived state may reveal whether a relationship exists between an RNs sleep and their medication error rate. The current literature does not address this, but as RNs generally have irregular sleep patterns due to shift work, it warrants further investigation—particularly as sleep is frequently mentioned by RNs as contributing towards errors. As insufficient data currently exist on the topic, the necessary evidence to support a change in clinical processes to improve patient safety is lacking. For this reason, the authors recommend future research that explores this topic in detail.

ACKNOWLEDGEMENTS

Open access publishing facilitated by La Trobe University, as part of the Wiley - La Trobe University agreement via the Council of Australian University Librarians.

FUNDING INFORMATION

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CONFLICT OF INTEREST STATEMENT

All authors declared that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

ETHICS STATEMENT

Ethical approval was not required for this scoping review.

ORCID

Christopher Vincent Martin https://orcid.org/0000-0002-5775-8934
Joanne Joyce-McCoach https://orcid.org/0000-0002-7270-4619
Monica Peddle https://orcid.org/0000-0003-4535-7129
Christine East https://orcid.org/0000-0002-1196-8426

REFERENCES

Abdar, M. E., Abdar, Z. E., Tajaddini, H., Bazrafshan, A., Khoshab, H., Tavan, A., Afsharpoor, G., Amiri, R. N. M., & Rafiei, H. (2014). Registered nurses perception of medication errors: A cross sectional study in southeast of Iran. *International Journal of Nursing Education*, *6*(1), 19–23. https://doi.org/10.5958/j.0974-9357.6.1.005

Asfour, L., Asfour, V., MCCormack, D., & Attia, A. (2014). In surgeons performing cardiothoracic surgery is sleep deprivation significant in its impact on morbidity or mortality? *Interactive Cardiovascular and Thoracic Surgery*, *19*(3), 479–487. https://doi.org/10.1093/icvts/ivu118

Australian Commission on Safety and Quality in Health Care. (2017). *National safety and quality health service standards* (2nd ed.). ACSQHC. https://www.safetyandquality.gov.au/sites/default/files/migrated/National-Safety-and-Quality-Health-Service-Standards-second-edition.pdf

Axelsson, J., Åkerstedt, T., Kecklund, G., & Lowden, A. (2004). Tolerance to shift work – How does it relate to sleep and wakefulness? *International Archives of Occupational and Environmental Health*, *77*(2), 121–129. https://doi.org/10.1007/s00420-003-0482-1

Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P., Russo, M. B., & Balkin, T. J. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: A sleep dose-response study. *Journal of Sleep Research*, *12*(1), 1–12. https://doi.org/10.1046/j.1365-2869.2003.00337.x

Bellebaum, K. L. (2008). The relationship between nurses' work hours, fatigue, and the occurence of medication administration errors (PhD). Ohio State University.

Boivin, D. B., & Boudreau, P. (2014). Impacts of shift work on sleep and circadian rhythms. *Pathologie Biologie*, *62*(5), 292–301. https://doi.org/10.1016/j.patbio.2014.08.001

Bolandianbafghi, S., Salimi, T., Rassouli, M., Faraji, R., & Sarebanhassanabadi, M. (2017). Correlation between medication errors with job satisfaction and fatigue of nurses. *Electronic Physician*, *9*(8), 5142–5148. https://doi.org/10.19082/5142

Booker, L. A., Magee, M., Rajaratnam, S. M. W., Sletten, T. L., & Howard, M. E. (2018). Individual vulnerability to insomnia, excessive sleepiness and shift work disorder amongst healthcare shift workers. A systematic review. *Sleep Medicine Reviews*, *41*, 220–233. https://doi.org/10.1016/j.smrv.2018.03.005

Borbély, A. A., Daan, S., Wirz-Justice, A., & Deboer, T. (2016). The two-process model of sleep regulation: A reappraisal. *Journal of Sleep Research*, *25*(2), 131–143. https://doi.org/10.1111/jsr.12371

Bucks, R. S., Olaithe, M., & Eastwood, P. (2013). Neurocognitive function in obstructive sleep apnoea: A meta-review. *Respirology (Carlton, Vic.)*, *18*, 61–70. https://doi.org/10.1111/j.1440-1843.2012.02255.x

Centre for Disease Control and Prevention. (2020). Pressure for sleep. https://www.cdc.gov/niosh/emres/longhourstraining/pressure.html

Chaiard, J., Deeluea, J., Suksatit, B., Songkham, W., & Inta, N. (2018). Short sleep duration among Thai nurses: Influences on fatigue, daytime sleepiness, and occupational errors. *Journal of Occupational Health*, *60*(5), 348–355. https://doi.org/10.1539/joh.2017-0258-OA

Chalasani, S. H., & Ramesh, M. (2017). Towards patient safety: Assessment of medication errors in the intensive care unit in a developing country's tertiary care teaching hospital. *European Journal of Hospital Pharmacy. Science and Practice*, *24*(6), 361–365. https://doi.org/10.1136/ejhpharm-2016-001083

Chalder, T., Berelowitz, G., Pawlikowska, T., Watts, L., Wessely, S., Wright, D., & Wallace, E. P. (1993). Development of a fatigue scale. *Journal of Psychosomatic Research*, *37*(2), 147–153. https://doi.org/10.1016/0022-3999(93)90081-p

Cheng, P., & Drake, C. (2019). Shift work disorder. *Neurologic Clinics*, *37*(3), 563–577. https://doi.org/10.1016/j.ncl.2019.03.003

Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M., & Moher, D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology*, *67*(12), 1291–1294. https://doi.org/10.1016/j.jclinepi.2014.03.013

Covidence Systematic Review Software (2021), Veritas Health Innovation, Melbourne, Australia.

Deans, C. (2005). Medication errors and professional practice of registered nurses. *Collegian (Royal College of Nursing, Australia)*, *12*(1), 29–33. https://doi.org/10.1016/S1322-7696(08)60480-1

Department of Health. (2019). Health workforce data. Factsheet, Nursing and Midwifery. Commonwealth of Australia. https://hwd.health.gov.au/resources/publications/factsheet-nrrn-2019.pdf

Di Simone, E., Fabbian, F., Giannetta, N., Dionisi, S., Renzi, E., Cappadona, R., Di Muzio, M., & Manfredini, R. (2020). Risk of medication errors and nurses' quality of sleep: A national cross-sectional web survey study. *European Review for Medical and Pharmacological Sciences*, *24*(12), 7058–7062. https://doi.org/10.26355/eurrev_202006_21699

Di Milia, L., Waage, S., Pallesen, S., & Bjorvatn, B. (2013). Shift work disorder in a random population sample – Prevalence and comorbidities. *PLoS One*, *8*(1), e55306. https://doi.org/10.1371/journal.pone.0055306

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *25*(1), 117–129.

Elmenhorst, D., Elmenhorst, E. M., Luks, N., Maass, H., Mueller, E. W., Vejvoda, M., Wenzel, J., & Samel, A. (2007). Performance impairment during four days partial sleep deprivation compared with the acute effects of alcohol and hypoxia. *Sleep Medicine*, *10*(2), 189–197. https://doi.org/10.1016/j.sleep.2007.12.003

Fathi, A., Hajizadeh, M., Moradi, K., Zandian, H., Dezhkameh, M., Kazemzadeh, S., & Rezaei, S. (2017). Medication errors among nurses in teaching hospitals in the west of Iran: What we need to know about prevalence, types, and barriers to reporting. *Epidemiology and Health*, *39*, e2017022. https://doi.org/10.4178/epih.e2017022

Flo, E., Pallesen, S., Magerøy, N., Moen, B. E., Grønli, J., Hilde Nordhus, I., & Bjorvatn, B. (2012). Shift work disorder in nurses – Assessment, prevalence and related health problems. *PLoS One*, *7*(4), e33981. https://doi.org/10.1371/journal.pone.0033981

Folkard, S. (2008). Do permanent night workers show circadian adjustment? A review based on the endogenous melatonin rhythm. *Chronobiology International*, *25*(2), 215–224.

Gorgich, E. A. C., Barfroshan, S., Ghoreishi, G., & Yaghoobi, M. (2016). Investigating the causes of medication errors and strategies to prevention of them from nurses and nursing student viewpoint. *Global Journal of Health Science*, *8*(8), 54448. https://doi.org/10.5539/gjhs.v8n8p220

Hammoudi, B. M., Ismaile, S., & Abu Yahya, O. (2018). Factors associated with medication administration errors and why nurses fail to report them. *Scandinavian Journal of Caring Sciences*, *32*(3), 1038–1046. https://doi.org/10.1111/scs.12546

Härkänen, M., Tiainen, M., & Haatainen, K. (2018). Wrong-patient incidents during medication administrations. *Journal of Clinical Nursing*, *27*(3–4), 715–724. https://doi.org/10.1111/jocn.14021

Haw, C. M., Dickens, G., & Stubbs, J. (2005). A review of medication administration errors reported in a large psychiatric hospital in the United Kingdom. *Psychiatric Services*, *56*(12), 1610–1613. https://doi.org/10.1176/appi.ps.56.12.1610

ICAO. (2015). Fatigue management guide for air operators (issue 2nd edition). https://www.icao.int/safety/fatiguemanagement/FRMS%20Tools/FMG%20for%20Airline%20Operators%202nd%20Ed%20(Final)%20EN.pdf

Keers, R. N., Williams, S. D., Cooke, J., & Ashcroft, D. M. (2013). Causes of medication administration errors in hospitals: A systematic review of quantitative and qualitative evidence. *Drug Safety*, *36*(11), 1045–1067. https://doi.org/10.1007/s40264-013-0090-2

Khosla, S., Deak, M. C., Gault, D., Goldstein, C. A., Hwang, D., Kwon, Y., O'Hearn, D., Schutte-Rodin, S., Yurcheshen, M., Rosen, I. M., Kirsch, D. B., Chervin, R. D., Carden, K. A., Ramar, K., Nisha Aurora, R., Kristo, D. A., Malhotra, R. K., Martin, J. L., Olson, E. J., … American Academy of Sleep Medicine Board of Directors. (2018). Consumer sleep technology: An American academy of sleep medicine position statement. *Journal of Clinical Sleep Medicine*, *14*(5), 877–880. https://doi.org/10.5664/jcsm.7128

Kohn, L. T., Corrigan, J., & Donaldson, M. S. (2000). *To err is human building a safer health system*. National Academy Press.

Kryger, M. H., Roth, T., & Dement, W. C. (2017). *Principles and practice of sleep medicine* (6th ed.). Elsevier.

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, *136*(3), 375–389. https://doi.org/10.1037/a0018883

Liu, D., Wu, Y., Jiang, F., Liu, Y., & Tang, Y.-L. (2021). The prevalence and associated factors of short sleep duration among nurses in tertiary public hospitals in China: Findings from a national survey. *Risk Management and Healthcare Policy*, *14*, 2547–2552. https://doi.org/10.2147/RMHP.S315262

Lowe, C. J., Safati, A., & Hall, P. A. (2017). The neurocognitive consequences of sleep restriction: A meta-analytic review. *Neuroscience and Biobehavioral Reviews*, *80*, 586–604. https://doi.org/10.1016/j.neubiorev.2017.07.010

Mendoza, T. R., Wang, X. S., Cleeland, C. S., Morrissey, M., Johnson, B. A., Wendt, J. K., & Huber, S. L. (1999). The rapid assessment of fatigue severity in cancer patients: Use of the brief fatigue inventory. *Cancer*, *85*(5), 1186–1196. https://doi.org/10.1002/(sici)1097-0142(19990301)85:5<1186::aid-cncr24>3.0.co;2-n

Mollayeva, T., Thurairajah, P., Burton, K., Mollayeva, S., Shapiro, C. M., & Colantonio, A. (2015). The Pittsburgh sleep quality index as a screening tool for sleep dysfunction in clinical and non-clinical samples: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *25*, 52–73. https://doi.org/10.1016/j.smrv.2015.01.009

Mollicone, D. J., Van Dongen, H. P. A., Rogers, N. L., & Dinges, D. F. (2008). Response surface mapping of neurobehavioral performance: Testing the feasibility of split sleep schedules for space operations. *Acta Astronautica*, *63*(7), 833–840. https://doi.org/10.1016/j.actaastro.2007.12.005

Morelock, S. G. (2014). Sustained vigilance, errors, and job satisfaction in a population of critical care and emergency department nurses. https://search.ebscohost.com/login.aspx?direct=true&AuthType=shib&db=ccm&AN=131792148&site=ehost-live&scope=site&custid=s5501413

Morgenthaler, T. I., Lee-Chiong, T., Alessi, C., Friedman, L., Aurora, R. N., Boehlecke, B., Brown, T., Chesson, A. L., Kapur, V., Maganti, R., Owens, J., Pancer, J., Swick, T. J., & Zak, R. (2007). Practice parameters for the clinical evaluation and treatment of circadian rhythm sleep disorders. *Sleep*, *30*(11), 1445–1459. https://doi.org/10.1093/sleep/30.11.1445

Murphy, M., & While, A. (2012). Medication administration practices among children's nurses: A survey. *British Journal of Nursing (Mark Allen Publishing)*, *21*(15), 928–933. https://doi.org/10.12968/bjon.2012.21.15.928

National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP). (1998). Taxonomy of medication errors. https://www.nccmerp.org/sites/default/files/taxonomy2001-07-31.pdf

Office of the National Rail Safelty Regulator (ONRSR). (2020). ONRSR guideline: Fatigue risk management. https://nraspricms01.blob.core.windows.net/assets/documents/Guideline/Fatigue-Risk-Management-Guideline-1-July-2022.pdf

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Parshuram, C. S., To, T, Seto, W., Trope, A., Koren, G., & Laupacis, A. (2008). Systematic evaluation of errors occurring during the preparation of intravenous medication. *Canadian Medical Association Journal (CMAJ)*, *178*(1), 42–48. https://doi.org/10.1503/cmaj.061743

Patel, S. R., Ayas, N. T., Malhotra, M. R., White, D. P., Schernhammer, E. S., Speizer, F. E., Stampler, M. J., & Hu, F. B. (2004). A prospective study of sleep duration and mortality risk in women. *Sleep*, *27*(3), 440–444. https://doi.org/10.1093/sleep/27.3.440

Perez-Pozuelo, I., Zhai, B., Palotti, J., Mall, R., Aupetit, M., Garcia-Gomez, J. M., Taheri, S., Guan, Y., & Fernandez-Luque, L. (2020). The future of sleep health: A data-driven revolution in sleep science and medicine. *NPJ Digital Medicine*, *3*(1), 42. https://doi.org/10.1038/s41746-020-0244-4

Peters, M. D. J., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *JBI Evidence Implementation*, *13*(3) https://journals.lww.com/ijebh/Fulltext/2015/09000/Guidance_for_conducting_systematic_scoping_reviews.5.aspx, 141–146.

Philibert, I. (2005). Sleep loss and performance in residents and nonphysicians: A meta-analytic examination. *Sleep*, *28*(11), 1392–1402. https://doi.org/10.1093/sleep/28.11.1392

Roughead, E. E., Semple, S. J., & Rosenfeld, E. (2016). The extent of medication errors and adverse drug reactions throughout the patient journey in acute care in Australia. *International Journal of Evidence-Based Healthcare*, *14*(3), 113–122. https://doi.org/10.1097/XEB.0000000000000075

Rutledge, D. N., Retrosi, T., & Ostrowski, G. (2018). Barriers to medication error reporting among hospital nurses. *Journal of Clinical Nursing*, *27*(9–10), 1941–1949. https://doi.org/10.1111/jocn.14335

Saadat, H., Bissonnette, B., Tumin, D., Thung, A., Rice, J., Barry, N. D., & Tobias, J. (2015). Time to talk about work-hour impact on anesthesiologists: The effects of sleep deprivation on profile of mood states and cognitive tasks. *Pediatric Anesthesia*, *26*(1), 66–71. https://doi.org/10.1111/pan.12809

Sateia, M. J. (2014). International classification of sleep disorders-third edition. *Chest*, *146*(5), 1387–1394. https://doi.org/10.1378/chest.14-0970

Scott, L. D., Rogers, A. E., Hwang, W.-T., & Zhang, Y. (2006). Effects of critical care nurses' work hours on vigilance and patients' safety. *American Journal of Critical Care*, *15*(1), 30–37. https://doi.org/10.4037/ajcc2006.15.1.30

Seki, Y., & Yamazaki, Y. (2006). Effects of working conditions on intravenous medication errors in a Japanese hospital. *Journal of Nursing Management*, *14*(2), 128–139. https://doi.org/10.1111/j.1365-2934.2006.00597.x

Stimpfel, A. W., Fatehi, F., & Kovner, C. (2020). Nurses' sleep, work hours, and patient care quality, and safety. *Sleep Health*, *6*(3), 314–320. https://doi.org/10.1016/j.sleh.2019.11.001

Suzuki, K., Ohida, T., Kaneita, Y., Yokoyama, E., & Uchiyama, M. (2005). Daytime sleepiness, sleep habits and occupational accidents among hospital nurses. *Journal of Advanced Nursing*, *52*(4), 445–453. https://doi.org/10.1111/j.1365-2648.2005.03610.x

Thomas, L., Donohue-Porter, P., & Stein Fishbein, J. (2017). Impact of interruptions, distractions, and cognitive load on procedure failures and medication administration errors. *Journal of Nursing Care Quality*, *32*(4), 309–317. https://doi.org/10.1097/NCQ.0000000000000256

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., … Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467–473. https://doi.org/10.7326/M18-0850

Van Dongen, H. P., Maislin, G., & Dinges, D. F. (2004). Dealing with inter-individual differences in the temporal dynamics of fatigue and performance: Importance and techniques. *Aviation, Space, and Environmental Medicine*, *75*(3 Suppl), A147–A154.

Vercoulen, J. H., Swanink, C. M., Fennis, J. F., Galama, J. M., van der Meer, J. W., & Bleijenberg, G. (1994). Dimensional assessment of chronic fatigue syndrome. *Journal of Psychosomatic Research*, *38*(5), 383–392. https://doi.org/10.1016/0022-3999(94)90099-x

Wakefield, B. J., Uden-Holman, T., & Wakefield, D. S. (2005). Administration error reporting survey. *Advances in Patient Safety: From Research to Implementation*, *4*, 475.

Watson, N. F., Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., Gangwisch, J., Grandner, M. A., Kushida, C., Malhotra, R. K., Martin, J. L., Patel, S. R., Quan, S. F., & Tasali, E. (2015). Recommended amount of sleep for a healthy adult: A joint consensus statement of the American Academy of sleep medicine and Sleep Research Society. *Sleep*, *38*(6), 843 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4434546/pdf/aasm.38.6.843.pdf

Weinger, M. B., & Ancoli-Israel, S. (2002). Sleep deprivation and clinical performance. *JAMA: The Journal of the American Medical Association*, *287*(8), 955–957. https://doi.org/10.1001/jama.287.8.955

Westbrook, J. I., Li, L., Lehnbom, E. C., Baysari, M. T., Braithwaite, J., Burke, R., Conn, C., & Day, R. O. (2015). What are incident reports telling us? A comparative study at two Australian hospitals of medication errors identified at audit, detected by staff and reported to an incident system. *International Journal for Quality in Health Care*, *27*(1), 1–9. https://doi.org/10.1093/intqhc/mzu098

Zhou, X., Ferguson, S. A., Matthews, R. W., Sargent, C., Darwent, D., Kennaway, D. J., & Roach, G. D. (2012). Mismatch between subjective alertness and objective performance under sleep restriction is greatest during the biological night. *Journal of Sleep Research*, *21*(1), 40–49. https://doi.org/10.1111/j.1365-2869.2011.00924.x

Zverev, Y. P., & Misiri, H. E. (2009). Perceived effects of rotating shift work on nurses' sleep quality and duration. *Malawi Medical Journal*, *21*(1), 19–21. https://doi.org/10.4314/mmj.v21i1.10984

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Martin, C. V., Joyce-McCoach, J., Peddle, M., & East, C. E. (2024). Sleep deprivation and medication administration errors in registered nurses—A scoping review. *Journal of Clinical Nursing*, *33*, 859–873. https://doi.org/10.1111/jocn.16912