Practice Update

Promoting Sleep in the Intensive Care Unit

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Abstract

Introduction: Intensive care nurses face several challenges to facilitating sleep in their critically ill patients. With its high noise levels, hectic around-the-clock activity and constant artificial lights, the intensive care environment does not foster sleep. Intensive care unit patients have significant alterations in their sleep architecture with frequent awakenings and lighter sleep; up to 50% of this sleep also occurs during the daytime. Sleep loss increases the risk of developing delirium (especially in elderly patients) and immune system impairment, which prolongs healing. The aim of this article was to develop an evidence-based bundle of nursing care activities that promote adult intensive care patients' sleep.

Methods: A broad search was conducted in PubMed, CINAHL, Cochrane Library, and McMaster plus using search words and Medical Subject Headings terms, such as sleep, intensive care unit, intensive care, critical care nursing, sleep promotion, music, white noise, earplugs, pain relief, absence of pain, nonpharmacological intervention, and mechanical ventilation. Eight recommendations emerged from this review: reduce noise, use earplugs and eye masks, use music, promote a natural circadian rhythm, manage pain, use quiet time, cluster nursing care activities at night, and optimize ventilator modes.

Conclusion: Promoting sleep within this patient population needs to be a higher priority for intensive care nurses. Sleep should be a focus throughout the day and night, in order to sustain patients' natural circadian rhythms. Novel research in this field could change the strength of these recommendations and add new recommendations to the bundle.

Keywords

intensive care, critical care nursing, sleep, circadian rhythm, bundle

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Maslow (1943) described sleep as a basic human need. Sleep is a rapidly reversible state of reduced awareness, activity, and metabolism (Kirsch, 2015); it is maintained by central nervous activity and affected by stimuli in our surroundings, including bright light, high pitched or sudden noises, activity, and temperature (Stubberud, 2015). An important aspect of sleep, of which intensive care nurses should be aware, is that rest does not replace sleep as the brain is only restored when it is asleep (Landis, 2011).

Poor sleep and circadian dysrhythmias are important contributors to developing delirium, especially in older adults (Auckley et al., 2018). The circadian rhythm is a universal, evolutionary mechanism that enables all animals to adapt to their surroundings and is influenced by exposure to changes in light and darkness. Physiological systems such as heartbeat, body temperature, hormone secretion, and wakefulness all change rhythmically throughout the day (Hannibal & Martiny, 2013). Our immune system, inflammatory responses, blood glucose regulation, gas exchange, hemostasis, and renal function are all affected by time of day and sleep patterns. Interrupting the circadian rhythm can disturb all of

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these regulatory systems, prolong healing, and even aggravate illness (Chan et al., 2012).

Intensive care unit (ICU) patients' sleep architecture is significantly altered (Auckley et al., 2018). The total amount of sleep these patients obtain is often relatively normal (i.e., 7–9 hours per day), but their sleep is also characterized by frequent awakenings and lighter stages. The amount of slow wave sleep and rapid eye movement sleep ICU patients experience may be excessively reduced or completely absent (Malik & Parthasarthy, 2014). Intensive care patients also get as much as 50% of their total sleep during the daytime hours (Boyko & Jennum, 2013). These factors not only negatively affect their recovery, they may also negatively influence their postrecovery sleep. Former patients have self-reported that their sleep quality in the ICU was an important contributing factor to sleep disturbances they experienced for up to a year after hospital discharge (Altman et al., 2017).

Nurses continuously observe their patients in the ICU, though the extent to which they attend to these patients' sleep quality and quantity is virtually unknown (Hopper et al., 2015). Ritmala-Castren et al. (2015) showed that nurses' documentation of their patients' sleep was inconsistent and did not correlate with the patients' own perceptions; the nurses tended to overestimate patients' sleep relative to self-report.

The current ICU trend is to use light or no sedation in critically ill, mechanically ventilated patients (Devlin et al., 2018). Clinical practice guidelines developed by the American College of Critical Care Medicine recommend that sedatives be titrated to maintain a light, rather than deep, sedation level. Maintaining light levels of sedation in adult ICU patients is associated with improved clinical outcomes, including shorter use of mechanical ventilation and a shorter ICU stay (Devlin et al., 2018). This presents intensive care nurses with new challenges to, and more responsibility for, promoting their patients' sleep.

The aim of this article was to develop an evidence-based bundle of recommendations for nonpharmacologic nursing care activities that promote sleep among adult intensive care patients.

Discussion of Topic

Data Sources

An in-depth search was conducted in PubMed, CINAHL, Cochrane Library, and McMaster Plus using the following search words and MesH terms: sleep, ICU, intensive care, critical care nursing, sleep promotion, music, white noise, earplugs, pain relief, absence of pain, nonpharmacological intervention, and mechanical ventilation (Table 1).

As recommended in the model for evidence-based practice, the search included relevant research highlighting scientific evidence, clinical experience, and patient perspectives (Polit & Beck, 2012). The first literature search was conducted from October 2015 to April 2016 and a several searches were carried out after this, the last one in January 2019. These searches were limited to articles published from 2006 to 2018. The inclusion criteria for single studies were that they had been performed in adult ICUs and that intensive care nurses, inpatients or former intensive care patients participated. Studies involving sedated patients were not excluded. Studies conducted in neonatal or pediatric units were excluded, as they are unlikely to generalize to patients in the adult ICU. Sleep apnea studies were also excluded. Only papers published in English or a Scandinavian language were included. All included articles were peer reviewed (Table 2). Many of the findings were single studies; the quality and validity of each was determined using The Norwegian Knowledge Centre for the Health Services checklist (Figure 1). We used Grading of Recommendations Assessment, Development and Evaluation to evaluate the strength of the recommendations. It is a suitable tool to evaluate the quality of the evidence and applicability of recommendations. It evaluates to which extend you can trust the recommendations will benefit the patient rather than harm, and the system offers two grades of recommendations: *strong* or *weak*. A strong recommendation means the desirable effects of an intervention clearly outweighs the undesirable effect and is therefore more applicable. A weak recommendation requires a more individual evaluation (Guyatt et al., 2008).

The eight nursing care activity recommendations in this bundle are based on the final 22 included articles. Because most of these studies were relatively limited and based on small samples, none are particularly conclusive on their own. However, their respective findings are also relatively similar and, thus, accentuate the challenges to, and available interventions for, improving sleep quality in the ICU. There is growing evidence that a combination, or a bundle, of strategies produce better outcomes compared with a single intervention (Polit & Beck, 2012). The aim of this recommendation bundle is to provide intensive care nurses with appropriate tools to promote their critically ill patients' sleep; these can be customized for individual patients (Table 3).

Noise Reduction (Strong Recommendation). Noise reduction is a very important aspect of sleep promotion in the ICU. Although the World Health Organization has recommended a peak level of 55 dB, noise levels in the ICU routinely exceed this level (Auckley et al., 2018). According to Xie et al. (2009), there is a significant correlation between noise levels >80 dB and both frequent awakenings and poor sleep quality. The most important

Table 1. Details of Population, Intervention, Comparison, and Outcomes.

	Population	Intervention	Comparison	Outcome
Mesh terms	Intensive care unit, intensive care, critical care, critical care nursing, critical illness	Clinical protocols, nursing assessment, clinical assessment tools, noise reduction		Sleep, circadian rhythm
Search words	*Critically ill*, *ICU*	Clinical guidelines, sleep promotion, promote sleep, Music, white noise, earplugs, pain relief, absence of pain, non-pharmacological intervention, mechanical ventilation	Pain, noise	Sleep quality, Sleep deprivation, sleep disturbance

Note. ICU = intensive care unit.

Table 2. Article Inclusion and Exclusion Criteria.

Inclusion criteria	Exclusion criteria
– Published from 2006 to 2018 – Full-text articles available in English or a Scandinavian language – Adult population (age ≥18) – Studies conducted in an adult intensive care unit, or including adult intensive care patients or participants who had been patients in the intensive care unit – Both studies on sedated patients and nonsedated patients were included – Peer reviewed	– Studies from neonatal or pediatric intensive care unit – Population age <18 – Studies published in languages other than English or a Scandinavian language – Studies on sleep apnea

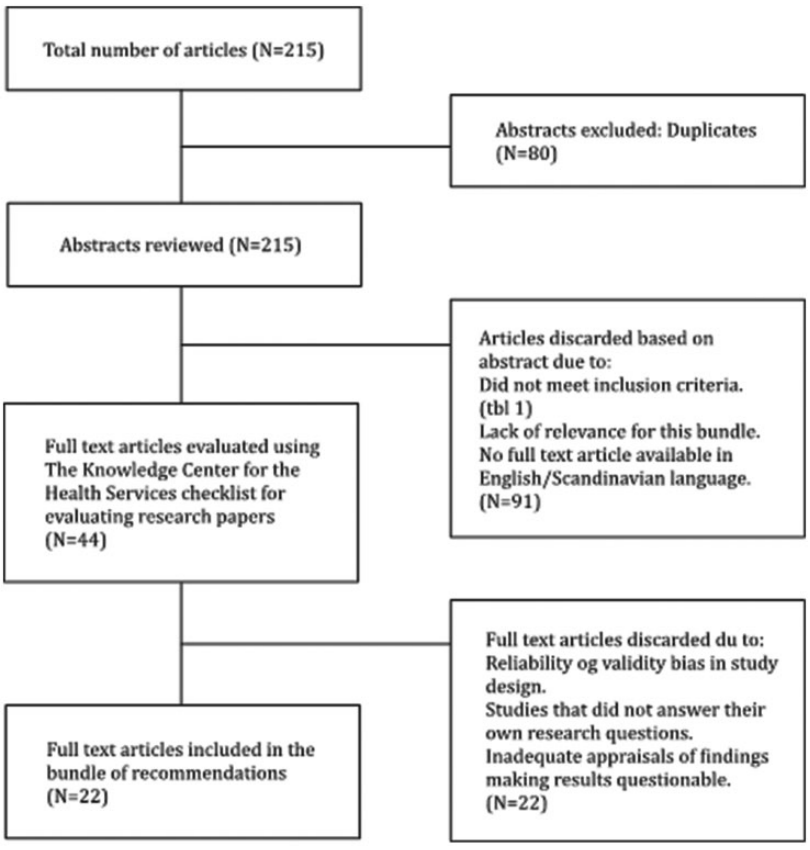

Figure 1. Article Inclusion and Exclusion Flowchart.

Table 3. Suggested Nursing Activities for Patients' Sleep Promotion.

I. Noise reduction	– Avoid unnecessary noise around the patient
	– Let the patient sleep in a single room if possible
	– Close the door to the patients room
	– Adjust alarm settings on monitor to fit the patients clinical picture
	– Lower alarms on medical equipment such as monitors and ventilators
	– Change electrocardiographic electrodes daily
II. Earplugs and eyemasks	– Use earplugs to reduce the patients perception of noise and promote sleep
	– Offer earplugs or eyemasks to patients who are awake and able to decide for themselves if they want to receive the measure
	– Help the patient to position the earplugs
III. Music to promote sleep	– Use classical music, or other noncommercial soothing music or music to patients choice if available
	– Let the patient listen to music during quiet periods without other disruptions for best effect
IV. Absence of pain	– Ensure that the patient is free of pain
	– Assess patients pain, and address it with sufficient analgesics if needed
	– Use pain scales or pain scoring tools such as NRS or CPOT
V. Quiet time	– Facilitate quiet periods during the day without interruptions, preferably between 2:00 and 4:00 p.m. which is a low point in the circadian rhythm and a time and when the body is naturally at rest
	– Inform other professional groups such as radiographers and physical therapists that this period is reserved for rest
	– Dim the lights and avoid talking and other unnecessary noise in the patient́s room in this period
VI. Promote a natural circadian rhythm	– Dim lights as much as possible in the patient's room at night
	– Ensure enough light during the day, avoid the patient laying in dimmed lights for long periods of time during the day
	– Give the patient enough stimuli during the day based on level of function
	– If possible, patient should be mobilized in the afternoon/ evening to improve night time sleep
VII. Clustering nursing care activities at night	– Reduce night time interruptions to secure the patient longer periods of *hands-off* time
	– Give the patient the opportunity to sleep thru a whole sleep cycle without interruptions (90–120 minutes)
VIII. Beneficial ventilator treatment	– Minimize central apnea
	– Avoid asynchrony with the ventilator

Note. CPOT = critical care pain observation tool; NRS = numeric rating scale.

tool for reducing ICU noise is changing staff attitudes and educating them about the consequences of noise for their critically ill patients. A study by Richardson et al. (2009) showed a successful reduction in average noise level from 96.48 dB to 77.52 dB after implementing a noise reduction protocol. It is important in this context to focus on staff awareness and implementing simple measures (e.g., closing doors to patients' rooms, lowering alarm levels on monitors, ventilators, and dialysis machines). Nurses report that they dread asking their colleagues to lower their noise levels, yet also express that they would appreciate it if someone made them aware if their own noise level was bothersome to a patient or colleague (Richardson et al., 2009).

Customizing monitors and other equipment alarm levels based on the patient's illness and changing electrocardiography electrodes daily can reduce the number of invalid alarms by 80% to 90% (Sendelbach et al., 2015). Invalid alarms not only cause noise but unnecessarily worry the awakened intensive care patient.

Use of Earplugs and Eye Masks (Weak Recommendation). Use of earplugs, either in isolation or as part of a sleep hygiene bundle, has been significantly associated with both sleep improvement and reduced risk of delirium (Litton et al., 2016). Many randomized controlled trials have shown that earplugs improve sleep quality (e.g., see Hu et al., 2015; Scotto et al., 2009; Van Rompaey et al., 2012). These studies all conclude that earplugs have a positive effect on participants' subjective experience of sleep and sleep quality in the ICU. Although some of these studies are limited due to their small sample sizes, this is an inexpensive measure that can be easily implemented in any ICU. It is important to note that earplugs and eye masks are only recommended for patients who are alert enough to cooperate and agree to these measures (Richardson et al., 2007). Despite the available evidence, research on the use of eye masks is limited and might be considered invasive, especially if the patient is unable to remove the mask without assistance (Richardson et al., 2007).

Music to Promote Sleep (Weak Recommendation). The use of music can increase patients' subjective sleep quality in the ICU. Randomized controlled trials using music to promote sleep have shown that patients receiving the

intervention report significantly better sleep quality, compared with those in control groups, on standardized sleep questionnaires (Ryu et al., 2012; Su et al., 2013). Dijkstra et al. (2010) have suggested that calming music also leads to deeper sedation levels in sedated patients. All of these studies have used noncommercial, calming, or classical music and recommend its use during quiet periods without other disruptions to achieve the best effect.

Absence of Pain (Weak Recommendation). Pain relief is an important precondition to healthy sleep in intensive care patients (Gardner et al., 2009; Maidl et al., 2014; Malik & Parthasarathy, 2014). Research on this topic is scarce, but as Malik and Parthasarathy (2014) point out, it is important that nurses measure and document patients' pain levels. This can be done using validated scoring tools such as the numeric rating scale or critical care pain observation tool. It is key that ICU nurses administer sufficient analgesics. One study in the postoperative ward emphasized that pain is the most important reason for reduced sleep quality (Nicolas et al., 2008). This is an ethically challenging research topic, as it is impossible to deprive some patients of sufficient pain relief in order to compare their sleep patterns with those whose pain is sufficiently alleviated. Thus, the evidence on the importance of pain management is inconclusive. One possible way to study this topic would be with qualitative interviews or questionnaires surveying current or former intensive care patients on their pain management experience and whether (and, if so, how) this affected their sleep quality or patterns in the ICU.

Quiet Time (Weak Recommendation). Allowing quiet time during the daytime hours has positive effects on intensive care patients' experience of sleep quality. The optimal time for this is between 2:00 and 4:00 p.m., during a naturally low point of the circadian rhythm, when the body is most receptive to rest (Dennis et al., 2010; Gardner et al., 2009; Maidl et al., 2014). During this period, lights should be dimmed, and noise levels kept as low as possible. To dim the lights on one hand contradicts the importance of natural daylight to secure a natural circadian rhythm, but dimming the lights encourage staff to reduce other environmental stimuli, which is important to give the patient a chance to rest (Maidl et al., 2014). Examinations, physiotherapy, and other interventions should be avoided during this period; some also recommend avoiding family visits at this time. Research on patients' melatonin secretion during quiet time has not been conclusive, but patients have reported better sleep quality and less anxiety in studies implementing quiet time in the ICU (Hedges et al., 2019; Maidl et al., 2014). Although this is another low-cost intervention, it may be less feasible. Daytime in the ICU is often hectic, with multiple examinations and interventions competing to fit within *office hours*.

Promote a Natural Circadian Rhythm (Weak Recommendation). The lack of natural variation in light exposure is an important factor that disturbs ICU patients' circadian rhythms (Billings & Watson, 2015). The combination of a lack of windows for exposure to natural daylight and 24-hour artificial light exposure negatively affect patients' circadian rhythms. Exposure to sufficient natural light suppresses daytime melatonin secretion, reduces daytime sleepiness, and positively affects nighttime sleep.

Engwall et al. (2015) have claimed that exposure to natural light–dark variations is even more important for critically ill patients than it is for those who are healthy. However, access to natural daylight is often limited in the ICU and artificial lights are often placed directly above hospital beds, which can be unpleasant for the patient. The multitude of vital functions negatively affected by circadian rhythm changes (e.g., immune system functioning, inflammatory responses, blood glucose regulation, gas exchange, hemostasis and renal function; Chan et al., 2012) all emphasize how important it is that we meet this challenge.

In modern hospital settings, nocturnal light affects our circadian rhythm less than does inadequate daytime light exposure (Auckley et al., 2018). Engwall et al. (2015) conducted a study in an intensive care environment using specialized, cycled light sources that changed in a rhythm, modeling the optimal outdoor natural light environment. Lamps were placed along the walls of the patients' room so that they did not impose on the patients, as did ceiling lamps. The results from the study showed significant differences in favor of the intervention room regarding factor for brightness in daytime. As Auckley et al. (2018) point out, it is important to get bright light in the morning and in the daytime to start up and support the circadian rhythm. Although this may be an ideal solution, one could question the feasibility in most ICUs.

The amount of stimulus and activity to which they are exposed during the daytime hours also affects patients' circadian rhythms; these natural cues impact our internal clock and have been proven to have a positive effect on nocturnal sleep (Billings & Watson, 2015). Mobilizing patients or adding physical activity adapted to their level of functioning prior to their nocturnal sleep time can both improve sleep and reduce the risk of delirium. In the ICU, access to physical therapists is often limited in the afternoon and evenings so that implementing this measure means an increased workload for intensive care nurses.

Clustering Nursing Care Activities at Night (Weak Recommendation). Patient care interventions are often cited as a reason for poor sleep in the ICU (Auckley et al., 2018). Some studies have shown that these patients rarely receive a full 90-minute period without nursing interventions that involve touching the patient (Patel et al., 2014; Ritmala-Castren et al., 2015). Without at least 90 minutes, the patient does not have the opportunity to complete one sleep cycle. Clustering nursing interventions would avoid multiple interruptions, allowing the patient more *hands-off* time to improve both sleep duration and quality (Auckley et al., 2018; Patel et al., 2014; Ritmala-Castren et al., 2015).

Beneficial Ventilator Treatment (Weak Recommendation). Ventilator treatment negatively affects sleep quality. Asynchrony with the ventilator and multiple alarms can cause stress, frequent awakenings, and reduced sleep quality (Billings & Watson, 2015; Hu et al., 2015; Malik & Parthasarathy, 2014). The goal of nocturnal ventilator treatment should be minimizing central apnea and asynchrony. Respiratory patterns normally change during sleep, possibly leading to hyperventilation on some ventilator modes, which can then lead to central apnea. Other modes can achieve greater synchrony during these periods of respiratory pattern change, reducing unnecessary alarms.

Some studies have also shown that tracheostomized patients with prolonged weaning time benefit from being reconnected to the ventilator at night to allow longer and better sleep (Rittayamai et al., 2016).

Some ventilator modes may be more beneficial than others. One study showed fewer central apneas during an assist control mode and less patient-ventilator asynchrony during a proportional assist mode (Auckley et al., 2018). New ventilator modes are promising in reducing asynchrony, but more research is needed to evaluate effects on sleep quality and quantity (Rittayamai et al., 2016).

Importance to Nursing Profession

Poor sleep among critically ill patients is associated with prolonged mechanical ventilation, risk of developing delirium, and prolonged length of hospital stay. These risk factors should be ample reason to increase our focus on promoting sleep in the ICU. Toward promoting ICU patients' sleep, it is important to increase nurses' knowledge about, and awareness of, the importance of sleep. Several measures described herein, that have been proven effective at improving patients' sleep, are simple and feasible to implement in the ICU.

Implications for Clinical Practice

Based on the cumulative evidence reviewed in these papers, it is clear that there are many challenges to promoting sleep in the ICU. Given the modern trend toward keeping intensive care patients awake more (i.e., under less sedation), promoting their sleep becomes even more important. It is essential that intensive care nurses have high-quality, well-validated tools to accomplish this goal. Using a combination, or bundle, of strategies produces better outcomes compared with a single intervention (Polit & Beck, 2012). Intensive care nurses need to remain mindful of their patients' sleep architecture and sleep quality throughout both day and night times. This article recommends a bundle of eight feasible, inexpensive measures to promote sleep to this patient group. However, given the strength according to the Grading of Recommendations Assessment, Development and Evaluation system for the most being weak, the emphasis for clinical practice must be on individualized application of these recommendations.

Implications for Future Research

More research is needed on this topic before definitive conclusions can be drawn. Given the importance of sleep to both physical and psychological well-being, both during hospitalization and postdischarge, this is a significant research field. One topic on which research is particularly scarce is the use of ventilator modes, including how these affect ICU patients' sleep and how we can actively use them to improve that sleep. This technology has advanced a great deal over the past decade; it would be valuable to determine how the various modes now available affect patients' sleep.

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