

Spring 4-14-2022

The Effect of the Sleep Promotion Interventions on Incidence of Delirium in Intensive Care Patients: An Integrative Literature Review

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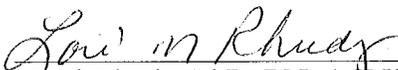
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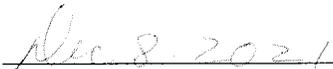
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The Effect of the Sleep Promotion Interventions
on Incidence of Delirium in Intensive Care Patients:
An Integrative Literature Review

A Scholarly Inquiry Paper
Submitted to the Faculty of the Department of Nursing
College of Nursing and Health Sciences
Of Winona State University

by
Sarah M. Lee

In Partial Fulfilment of the Requirements
For the Degree of
Master of Science: Nurse Educator

April 14th, 2022

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Sarah M. Lee

Acknowledgement

I would like to express my heartfelt gratitude to Dr. Diane Forsyth, my advisor and committee chair and Dr. Sandra Paddock, my advisor, who guided me throughout this scholarly inquiry paper. Their ongoing support and insightful feedback contributed immensely for the completion of this project. I would also like to thank Dr. Lori Rhudy, the committee member, for her time and recommendations to refine the paper even further. Lastly, I wish to acknowledge the love and patience of my husband, Big Nathan, and our children, Nathan and Ethan, during this process.

Abstract

Sleep is vital to our health, and prolonged sleep deprivation can result in serious health problems. Yet, patients in the intensive care unit (ICU) commonly experience sleep deprivation due to the environment and necessary treatments. High noise levels, bright lights, frequent patient care activities, mechanical ventilator desynchrony, pain, anxiety, and medications are the main factors that disrupt patients' sleep architecture and affect sleep quality. Sleep deprivation is a significant contributor to the development of delirium, which is associated with poor patient outcomes and added financial burden. Implementation of sleep promotion interventions may decrease the incidence of this detrimental illness. The purpose of this integrative literature review was to explore sleep promotion interventions and their efficacy on reducing the incidence of delirium in critically ill patients. Eight research studies of varying levels of evidence, including one clinical practice guideline and three systematic reviews, were analyzed. Based on the literature review, the effectiveness of sleep promotion interventions for decreasing the prevalence of delirium is inconclusive. However, most research concluded a bundle of interventions was effective in improved sleep quality. With poor sleep, one of the modifiable factors on delirium in the ICU, bedside nurses can play a crucial role in preventing delirium by implementing a bundle of sleep promotion interventions.

Keywords: Sleep, sleep promotion, sleep promotion bundle, ICU, delirium

Table of Contents

	Page
LIST OF TABLES	vii
LIST OF FIGURES	viii
SECTION OF HEADINGS	
I. INTRODUCTION	
A. Introduction	1
B. Background	2
C. Purpose and Clinical Nursing Question	3
D. Method Used for the Inquiry	3
II. LITTERATURE REVIEW	
A. Introduction	3
B. Search Strategy	4
C. Appraisal and Themes	4
D. Review of Practice Guidelines	7
E. Review of Systematic Reviews and Meta-Analyses	9
III. CONCEPTUAL Map	
A. Conceptual Map	12
IV. CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS FOR NURSING	
A. Conclusions	12
B. Recommendations	13
C. Summary	14
REFERENCES	16

APPENDIX A. AGREE II TOOL	33
APPENDIX B. CHECKLIST FOR SYSTEMATIC REVIEWS AND RESEARCH SYNTHESES	40

LIST OF TABLES

Table	Pages
1. Literature Table for Sleep Promotion Interventions	20
2. Level of Evidence	31

List of Figures

Figure	Pages
1. Conceptual map of research literature reviewed	32

Introduction

Sleep deprivation is common in the intensive care unit (ICU). Various factors, including environment, ventilator, and medications, often influence sleep. Sleep deprivation is associated with the occurrence of delirium and impairs physical, immunological, and neurocognitive function (Litton et al., 2016). Delirium is a complex syndrome depicted by inattention, impaired ability to focus, and decreased processing of sensory information (Krešević et al., 2020). Delirium affects up to 87% of the patients in the intensive care unit (ICU) (Kang et al., 2018) and is associated with an increase in mortality rate, extended hospital stays, and additional healthcare costs (Martinez, 2017).

The Society of Critical Care Medicine (SCCM) published the updated *Clinical practice guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep disruption (PADIS) in Adult Patients in the ICU* (Devlin et al., 2018). One of the most significant changes from the 2013 guidelines was the addition of immobility and sleep disruption management components. Devlin et al. (2018) recognized sleep as a potentially modifiable risk factor influencing recovery in critically ill adults. Therefore, implementing interventions to promote quality sleep in the ICU is imperative for better patient outcomes.

The ICU environment does not promote rest and sleep because of constant alarms, lighting, and patient care activities, to name a few. Although some alarms are necessary for patient care, modifications can be made to assist a natural circadian rhythm in promoting sleep for the patients in the ICU. Implementing various nonpharmacological sleep interventions offers inexpensive tools to improve sleep quality in ICU patients and potentially reduce delirium. Critical care nurses have a unique and crucial role in fostering sleep-promoting interventions in the ICU, where life-saving interventions are the top priority.

Background

The high prevalence of delirium in the ICU has been documented for decades, but little effort to decrease the occurrence and the action plans to manage it have been reported.

According to Weinhouse et al. (2009), older patients with pre-existing cognitive impairment, sensory impairment, poor functional status, immobility, multiple co-morbid medical problems, alcohol abuse, depression, and cancer are at heightened risk for delirium. The risk of developing delirium is further increased with additional precipitating factors such as benzodiazepines, restraints, and sleep deprivation.

The sleep structure in ICU patients is significantly altered. The total amount of sleep these patients obtain is relatively normal, but they experience increased fragmentation, daytime sleeping, and longer periods of light sleep (Grimm, 2020). Factors contributing to sleep deprivation in the ICU include but are not limited to, acute illness, pain, medication effects, psychological factors, mechanical ventilators, noise, lighting, and patient care activities. Poor sleep contributes to emotional distress, prolonged duration of mechanical ventilation, deranged immune function, neurocognitive dysfunction, and ICU delirium (Devlin et al., 2018). Assessing and managing modifiable factors to increase sleep quality may reduce these detrimental adverse effects.

Often, sleep promotion interventions are inconsistent at night. Rules on noise reduction from conversations and alarms for nights may be lacking. An adjustment on lighting may depend on the nurse's preference or the patient's request, if able. Patient care activities, such as assessments, baths, and medication administration, may occur in favor of the nurse's schedule instead of the patient's sleep cycle. Moreover, patients are often left in bed during the daytime

without their mobility and alertness maximized. Lack of guidelines on sleep interventions challenges clinicians in providing consistent sleep routines for their patients.

Purpose and Clinical Nursing Question

Despite the SCCM's PADIS guidelines, the sleep hygiene bundle has not been implemented in the ICUs widely. The purpose of this integrative literature review is to identify evidence-based approaches for the effectiveness of sleep hygiene interventions among an adult population in the ICU in the prevention of delirium and to offer clinical recommendations for future implementations in an ICU setting. The clinical question to guide the literature review and obtain the most relevant evidence is: in critically ill adult patients in the ICU, what are the sleep promotion interventions to promote quality sleep and decrease the incidence of delirium during their ICU stay?

Method of Inquiry

An integrated literature review offers new knowledge about a topic by reviewing, critiquing, and synthesizing selected literature in an integrated way. Gray et al. (2017) define an integrated review of literature as following, "through synthesis and integration, one can cluster and connect ideas from several sources to develop a personal overall view of the topic" (p.133). In the next section, an integrated literature review process was utilized to discover evidence necessary to answer the clinical question on sleep hygiene

Literature Review

This section includes a comprehensive overview of the integrative literature review, including synthesis and analysis of research findings. Three common themes are discussed in detail from the studies reviewed about various sleep promotion interventions. Table 2 shows the levels of evidence assigned to each study based on "the methodological quality of their design,

validity, and applicability to patient care” (Ackley et al., 2008, p. 7). The Appraisal for Guidelines for Research and Evaluation (AGREE) II tool was used to evaluate the PADIS Clinical guidelines from SCCM (see Appendix A), and the Checklist for Systematic Reviews and Research Syntheses by Joanna Briggs Institute (2017) was utilized for reviewing systematic reviews and meta-analyses (see Appendix B).

Search Strategy

Based on the clinical nursing question, a comprehensive literature search was conducted using PubMed, Academic Search Premier, APA PsycArticles, CINAHL Complete, Consumer Health Complete- and EBSCO MegaFILE via EBSCOhost. The key terms used were *sleep intervention or sleep hygiene, ICU or intensive care unit or critical care, and delirium prevention or preventing delirium or reducing delirium*. The search was limited to all adults and the articles written in the English language and published from 2010 to 2021. Studies related to medications were excluded. Out of 11 articles, five articles were selected for inclusion from the search. Another literature search was conducted using PubMed with the key terms of *sleep, intensive care, and delirium*. Filters were applied to limit the search for age 19 and over, and the article type was limited to full text in the last ten years of publishing date. From 55 results, two items were selected for review, excluding the articles on medications, interventions unrelated to sleep promotion, and the duplicates from the previous search.

Level of Evidence

Nine sleep promotion interventions were retrieved after a review of eight articles with various levels of evidence. Three systematic reviews and a comprehensive clinical guideline offered level I evidence according to Sackett’s Level of Evidence, although most of the studies within the literature were relatively limited and based on small samples (Ackley et al., 2008).

Three studies utilized a quasi-experiment design and pre and post studies, which are level III, and one study was a literature review with expert opinions, considered level VII. The definition of evidence level can be seen in Table 2.

Factors Affecting Sleep and Appraisal

Noise Reduction

Noise in the ICU is one of the most detrimental factors on sleep among ICU patients. The World Health Organization has recommended a peak level of 45 decibels (dB) during the day and 35 dB at night, but the average ICU sound level within a 24-hour range is between 55 dB and 65 dB (Pisani & D'Ambrosio, 2020). A direct correlation between earplug use and reducing delirium was implicated in six articles (Beck Edvardsen & Hetmann, 2020; Litton et al., 2016; Locihová et al., 2018; Patel et al., 2014; Pisani & D'Ambrosio, 2020; Rudolph et al., 2014) and all eight studies concluded that earplugs have a positive effect on sleep quality in the ICU. The other interventions to decrease noise levels included lowering phone volume and silencing alarms in patients' rooms (Beck Edvardsen & Hetmann, 2020; Patel et al., 2014; Pisani & D'Ambrosio, 2020). Beck Edvardsen and Hetmann (2020) recommended customizing monitors and other equipment alarm levels based on the patient's illness and changing electrocardiography electrodes daily. Patel et al. (2014) included offering single-use earplugs to all patients with a Richmond Agitation Sedation Scale (RASS) score greater than -4 as a bundled intervention. In their study, the implementation of the intervention bundle resulted in a reduction in the incidence of delirium (33% before vs 14% after, $p < 0.001$).

Light Reduction

Most literature included applying or offering eye masks as a light reduction strategy. However, no study showed a direct correlation between light reduction as a single intervention

and the incidence of delirium. Eye masks were used with earplugs and other interventions such as bedside lighting and decreasing lighting intensity as a bundle component.

Patel et al. (2014) implemented nonpharmacological bundle interventions, including light level reduction. To reduce light, they offered single-use eye masks to all patients with a RASS score greater than -4, used bedside lighting when performing nighttime care activities, and dimmed the main ICU lights between 2300 and 0700. With these light reduction interventions as a part of the bundle, there was a reduction in the incidence of delirium (33% before and 14% after, $p < 0.001$) and in the mean (SD) length of time spent delirious (3.4 days before and 1.2 days after, $p = 0.021$). In their literature review, Pisani et al. (2020) also recommended sleep masks, offsetting light rather than overhead, and reducing the intensity of light to reduce bright light during typical sleep hours as one of the non-pharmacologic treatments to improve sleep in critically ill patients.

Devlin et al. (2018) drew their rationale on recommending eyeshades with concurrent use of earplugs and did not exclusively discuss the effectiveness of eyeshades by themselves. However, they concluded that the use of earplugs and eyeshades could be applied to all ICU patients to improve sleep quality and reduce delirium. Similarly, Locihová et al. (2018) claimed a positive effect of eye masks and earplugs on sleep quality from their systematic review, and two articles they reviewed included a statistically significant reduction in the incident of delirium with the use of eye mask and earplugs ($p = 0.02$; $p = 0.01$). However, Beck Edvarsen and Hetmann (2020) shared concern on the eye mask use, which might be considered invasive, especially for the patients who cannot remove the mask without assistance.

Patient Care Adjustment

Several studies recommended adjusting patient care activities such as limiting sleep interruption, grouping cares and increasing daytime mobility and alertness to promote sleep quality and decrease the incidence of delirium. Patel et al. (2014) incorporated seven nursing interventions related to patient care: grouping care, limiting care between 2300 and 0800, orienting patients, medication review for patients with positive Confusion Assessment Method for the Intensive Care Unit (CAM-ICU), setting appropriate sedation target, spontaneous breathing assessment and trial for ventilated patients, hourly pain assessment and management, and early mobilization. After implementing the multi-component bundle intervention, they found a statistically significant reduction in the incidence of delirium and the mean length of time spent in delirium. Beck Edvarlsen and Hetmann (2020) also suggested a bundle of nursing care activities such as clustering nursing care activities at night and increasing daytime stimulus and activity. Yet, the study lacks the correlation between the interventions and the incidence of delirium. Knauert et al. (2019) investigated whether restricting non-urgent bedside care between 0000 and 0359 would decrease in-room activity and sound levels. The study resulted in reduced-room activity and noise level reduction, and the authors concluded this intervention could promote sleep. However, no data were included on sleep quality improvement or ICU delirium reduction from this intervention.

Review of Practice Guidelines

With the new addition of the sleep disruption portion in the latest publication in 2018, the clinical practice guidelines for the Prevention and Management of PADIS (Devlin et al., 2018) provide expansive recommendations on managing adult patients in the ICU. The *Appraisal of Guidelines for Research & Evaluation II (AGREE II) Instrument* was utilized to determine the

quality of the guidelines. Although this review is focused on sleep disruption, the complete guidelines were evaluated.

Four appraisers who reviewed the PADIS guidelines (Devlin et al., 2018) were nursing graduate students with years of critical care or acute care nursing experience. The quality score was calculated for each of the six AGREE II domains, followed by an overall guideline assessment rating and recommendation on the use of the guidelines. The completed AGREE II score sheet with comments and ratings on each question can be seen in Appendix A.

Overall assessment of Domains one, two, four, and five has relatively high scores between 6 and 7 except Item 19 (recommendations into practice) with an average score of 5.5. The low scores in item 19 reflect poor scoring due to a lack of algorithms and strategies to apply the recommendations into practice. Articles 13 (externally reviewed by experts) and 14 (procedure for updating the guidelines) have a low score of 1 due to a lack of external review and information about guideline updates.

In Domain one, all items were covered very well, with explanations regarding objectives, target population, questions used, and whom it applies to. In Domain two, stakeholder involvement was covered relatively well. Authors and their credentials were listed, as well as the distribution of stakeholders and target audience. Prioritization of topics is clearly explained, as well as methodologies used. Supplemental Appendix A explains in detail the decision-making involved for outcomes. More importantly, “ICU survivors” were consulted to help guide decision-making.

In Domain three, items were explained clearly for the most part, including populations used, electronic databases, study designs, formulating recommendations. The purpose and intent of the external review were not well-defined, nor was there a procedural method or timeline for

updating these guidelines. In Domain four, the number of interventions is extensive. An index at the beginning of the guidelines would be helpful to guide the reader and allow the information to be better organized. The linking of appendices made interpretation of information more difficult/cumbersome, and we recommend instructions on reading the recommendations and suggestions versus using links. Some ungraded statements did not clearly define indicators, making it somewhat challenging to interpret what the authors were trying to convey. The reviewers appreciate that since these guidelines are subjective, they are not as easy to give proper guidelines.

In Domain five, applicability was, at times, vague. Facilitators and barriers are clearly explained, but no clinical algorithm was identified, nor details of costs, staff, or budgetary concerns. At the end of the report, there is a link for tools to implement these changes, but it does not work. A more straightforward explanation of the resource implications, as well as tools to implement these guidelines, would be helpful. Lastly, Domain six, editorial independence, is well explained but not found on the main page. The reader must use a link to find these details in “Supplemental Index A.”

In conclusion, based on the overall quality score of 6.12 out of 7 and 87% on the Agree II Tool, the reviewers recommend using these guidelines with some modifications for clarity. The guidelines provide clear recommendations with the level of quality on each topic accompanied by evidence-based rationale and evidence gaps.

Review of Systematic Reviews and Meta-Analyses

The systematic reviews and meta-analyses were reviewed by utilizing *the Checklist for Systematic Reviews and Research Syntheses* by the Joanna Briggs Institute (2017). This checklist provides a tool “to assess the methodological quality of study and determine the extent

to which a study has addressed the possibility of bias in its design, conduct and analysis” (Joanna Briggs Institute, 2017, p. 2). Two systematic reviews and a meta-analysis were assessed, and their strengths and weaknesses were determined by answering eleven questions on the checklist.

Beck Edvardsen and Hetmann. (2020). Beck Edvardsen and Hetmann (2020) presented high-quality evidence by synthesizing the data in their systematic review. This systematic review made recommendations on eight nursing care activities. The quality and validity of each study were determined using The Norwegian Knowledge Centre for the Health Services checklist, and the strength of the recommendations was evaluated using GRADE. The authors recommended developing a bundle of eight nursing care activities that promote sleep in adult intensive care units. These activities were: noise reduction, earplugs and eyemasks, music, absence of pain, quiet time, promoting a natural circadian rhythm, clustering nursing care activities at night, and beneficial ventilator treatment. The authors presented recommendations for practice based on the results of the review and the strength of the findings. Although there were no data on the relationship between the interventions and delirium, this study was included due to the variety of sleep interventions recommended.

Litton et al. (2016). This systematic review and meta-analysis studied the efficacy of earplugs as a single intervention or part of a bundle for reducing delirium based on five randomized control trials (RCTs) and four non-randomized, interventional studies. The authors utilized various statistical results, including relative risk (RR), confidence interval (CI), heterogeneity, sensitivity analysis, and tools such as the funnel plot to provide information on reliability. The weakness of the literature was the studies analyzed were primarily small, single-center studies with a high risk of bias. However, they concluded that placing earplugs in patients in ICU, either in isolation or with other interventions, is associated with a significant reduction in the incidence of delirium.

Locihová et al. (2018). The authors describe this review as a systematic review, but it merely summarizes the articles versus synthesizing and appraising. The authors failed to utilize a single tool to assess the effectiveness of the interventions but listed the tools that each study used. The inclusion criteria were vague. The only inclusion criteria listed were the time frame of 1990-2015 and full text, which did not address any elements of the research question. The clinical question of “to confirm whether selected nonpharmacological interventions (earplugs, eyemasks) have a positive effect on the quality of sleep in ICU patients” was not answered clearly but was embedded in the middle of the discussion section (p.2). The authors did include three studies (two RCTs and a pre-post study) that have a significant reduction in the incidence of delirium but specified the interventions (earplugs and eyemasks) were in only one study they reviewed. There was no discussion on the methods to minimize errors in data extraction or assessment of the likelihood of publication bias. The recommendation for nursing practice for sleep-promoting strategies contained alternative and complementary practices and did not support the study findings. Overall, the differences in sleep assessment methodology in individual studies do not allow for a complete comparative systematic analysis, although they offered detailed results from each study.

Systematic reviews and meta-analyses provide the highest quality evidence on a research topic when conducted in the appropriate methods and steps. Based on the results of the systematic reviews and meta-analyses, noise reduction with earplugs demonstrated the highest efficacy on sleep promotion with the most substantial evidence and is recommended to be used as part of a bundle to reduce delirium in the ICU. The other interventions recommended by the systematic reviews and meta-analyses above and the four studies can be grouped as light reduction interventions and patient care adjustment.

Conceptual Map

Conceptual maps visually illustrate the relationship between the concepts. Figure 1 depicts the main concept, sleep promotion interventions, with their antecedents and consequence. The concept includes nine individual interventions in three categories; the noise reduction intervention for earplugs, decreasing phone volume, and alarm silenced in patients' rooms; the light reduction interventions for eye masks, using bedside lighting, and reducing the intensity of lighting; and the patient care adjustment interventions for limiting sleep interruption, grouping cares and increasing daytime mobility and alertness. What leads to the interventions are the factors contributing to poor sleep quality in the ICU. Noise, lighting, patient care activities, mechanical ventilation, pain and anxiety, and medications are the common barriers for critically ill patients to experience the quality of sleep they had prior to the hospitalization. The outcome (consequence) from implementing sleep promotion interventions is the incidence of delirium. The relationships between each intervention and delirium are depicted per each article reviewed.

Conclusions

Sleep disturbance is profound in ICU and is yet a potentially modifiable risk factor for decreasing delirium among critically ill patients. Several studies showed that implementing simple nursing interventions improved the quality of sleep and reduced the incidence of delirium. Most studies concluded that implementing a bundle of sleep promotion interventions was associated with a significant reduction in the risk of delirium. The nonpharmacological interventions involve placing earplugs, decreasing phone volume, silencing alarms in patients' rooms, placing eye masks, using bedside lighting, reducing lighting intensity, limiting sleep interruption, grouping cares, and increasing daytime mobility and alertness. ICU bedside nurses

can play a crucial role in preventing delirium by proactively incorporating holistic nursing care to promote adequate sleep in critically ill patients.

Recommendations

Recommendations for Research

Evidence notes sleep disruption contributes to ICU delirium. Although there are numerous studies on the factors affecting sleep architecture in patients in the ICU, more research on a direct relationship between sleep interventions and the incidence of delirium is needed. Among those researches, most research findings are considered weak due to small sample sizes, non - randomized control cohorts, and lack of blinding. Future research with larger sample size from multiple sizes will increase reliability.

Once the sleep prevention protocol is established, educating nurses on implementation requires excellent planning. There is a plethora of research on patient outcomes, but little research has been done regarding educating nurses on implementing sleep prevention intervention. Future research on how different teaching strategies yield increased compliance of clinicians can help implement the interventions more effectively.

Recommendations for Education

An essential tool for implementing sleep promotion interventions in the ICU is changing staff attitudes and educating them about the consequences of sleep deprivation for their patients. Education on ICU delirium is pivotal. It should include the prevalence, pathophysiology, risk factors, screening tools, consequences such as re-intubation rate, ICU re-admission rate, mortality rate, length of hospital stay, and medical cost associated with ICU delirium. Increasing staff awareness of this detrimental illness can raise the acceptance of the practice change.

Light sedation verses deep sedation in critically ill and mechanically ventilated adult patients has been in the guidelines since 2013 (Devlin et al., 2018). It is imperative that ICU nurses receive strategic education on how to manage light sedation while ensuring patient comfort and how to increase daytime mobility to promote better sleep at night on ventilated patients. This practice change may be perceived as a higher workload for ICU nurses. Interprofessional education with the department of physical therapy and occupational therapy along with the participation of nursing assistants, can advance the change in a collaborative way.

Recommendations for Nursing Practice

For a successful implementation of the sleep promotion bundle, the following three components should be developed. One of the steps is to select a team of unit champions who can be the leaders, resources, and demonstrators of this bundle implementation. The nurses and nursing assistants who were motivated by the education provided prior to the selection would be ideal candidates for the unit champions. Another crucial step is to create clear guidelines for the nursing staff to follow. In addition to the full guidelines stored in an easily accessible place, convenient reminders such as a bedside checklist and a toolkit containing ear plugs and eyemasks can be helpful for daily usage. Finally, establishing documentation on the bundle elements will help validate the actions taken and can be utilized for future projects.

Summary

Sleep disturbances in critically ill patients are one of the possible risk factors for delirium. Some of the factors causing poor sleep in the ICU are modifiable with simple interventions from bedside clinicians. Although the data supporting the interventions effective for reduction in delirium are insufficient, all articles reviewed for this integrative review supported improvement in sleep quality after implementing a bundle of sleep promotion

interventions. The collaborative effort to reduce noise and bright light at night and to adjust patient care activities can assist ICU patients to have better quality sleep and ultimately can reduce the incidence of delirium.

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- Weinhouse, G. L., Schwab, R. J., Watson, P. L., Patil, N., Vaccaro, B., Pandharipande, P., & Ely, E. W. (2009). Bench-to-bedside review: Delirium in ICU patients - importance of sleep deprivation. *Critical Care (London, England)*, *13*(6), 234.
<https://doi.org/10.1186/cc8131>

Table 1*Literature Table for Sleep Promotion Interventions*

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
Beck Edvardsen, J., & Hetmann, F. (2020). Promoting sleep in the intensive care unit. <i>SAGE Open Nursing</i> , 6, 2377960820930209. https://doi.org/10.1177/2377960820930209 PubMed	To develop an evidence-based bundle of nursing care activities that promote adult intensive care patients' sleep.	Total number of articles: 22 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 non-sedated patients were included – Peer reviewed	Systematic review. 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.	The eight nursing care activity recommendations in this bundle - Reduce noise - use ear plugs and eye masks - use music - promote a natural circadian rhythm - manage pain - use quiet time - cluster nursing care activities at night - optimize ventilator modes - Eye masks (weak evidence) – invasive if patient unable to remove	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.	Importance of increasing nurses' knowledge about, and awareness of, the importance of sleep A combination, or a bundle, of strategies produce better outcomes compared with a single intervention	I

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
Devlin, J. W., Skrobik, Y., Gélinas, C., Needham, D. M., Slooter, A., Pandharipande, P. P., Watson, P. L., Weinhouse, G. L., Nunnally, M. E., Rochweg, B., Balas, M. C., van den Boogaard, M., Bosma, K. J., Brummel, N. E., Chanques, G., Denehy, L., Drouot, X., Fraser, G. L., Harris, J. E., Joffe, A. M., ... Alhazzani, W. (2018). Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. <i>Critical Care Medicine</i> , 46(9), e825–e873. https://doi.org/10.1097/CCM.00000000000003299 Pub-Med	To update and expand the 2013 Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium in Adult Patients in the ICU.	Critically ill patients in the ICU	Evidence-based clinical practice guidelines based on systematic reviews of RCTs or three or more RCTs Systematic Review Thirty-two international experts, four methodologists, and four critical illness survivors met virtually at least monthly. Content experts, methodologists, and ICU survivors were represented in each of the five sections of the guidelines: Pain, Agitation/sedation, Delirium, Immobility (mobilization/rehabilitation), and Sleep (disruption).	The Pain, Agitation/Sedation, Delirium, Immobility (mobilization/rehabilitation), and Sleep (disruption) panel issued 37 recommendations (three strong and 34 conditional), two good practice statements, and 32 ungraded, nonactionable statements. Three questions from the patient-centered prioritized question list remained without recommendation.	Recommending - assist-control ventilation at night (vs pressure support ventilation) - Noise and light reduction strategies - A sleep promoting multi-component protocol Not recommending - aromatherapy, acupressure, or music at night - the use of melatonin, dexmedetomidine, or propofol at night for sleep	Only the disruption of sleep section will be used in the paper. It suggests that a multi-component protocolized approach, but no specific combinations of interventions are discussed. Low or very low quality of evidence due to a lack of blinding. See Appendix A for appraisal.	I

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Grimm J. (2020). Sleep deprivation in the intensive care patient. <i>Critical Care Nurse</i>, 40(2), e16–e24. https://doi.org/10.4037/ccn2020939</p>	<p>To review the current literature on sleep deprivation in the intensive care unit setting and present care guidelines in a concise format.</p>	<p>ICU setting</p>	<p>Literature review</p> <p>Sleep monitoring – Difficult to assess. Tools: Actigraphy or polysomnography (PSG): most reliable but not realistic or cost-effective in ICU</p>	<p>Sleep deprivation is becoming an increasingly prevalent problem in the ICU population and can lead to difficulties with sleep well beyond the stage of critical illness.</p>	<p>Lack of reliability and validity of sleep assessment tools used in the studies</p>	<p>Nonpharmacological approaches -Noise reduction - Reducing the frequency of care interventions -Eliminating continuous light exposure -Medication adjustment</p>	<p>VII</p>

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Knauert, M. P., Pisani, M., Redeker, N., Murphy, T., Araujo, K., Jeon, S., & Yaggi, H. (2019). Pilot study: An intensive care unit sleep promotion protocol. <i>BMJ open respiratory research</i>, 6(1), e000411. https://doi.org/10.1136/bmjresp-2019-000411</p>	<p>To test the impact of an intensive care unit (ICU) sleep promotion protocol on overnight in-room disturbance.</p>	<p>A 38-bed medical ICU (MICU) of an academic, tertiary hospital. In total, 56 patients were enrolled and randomized to usual care ($n=30$) or sleep protocol ($n=26$). The mean age of enrolled patients was 62.5 years.</p> <p>Setting: a hospital-wide quiet protocol in place from 23:00 to 06:00 in which hallway lights are dimmed, and overhead pages are limited. All patients receive a quiet pack with earplugs, an eye mask and television headphones. All patient rooms are private with three solid walls and one glass wall, which includes the room doorway.</p>	<p>Quasi-experimental design.</p> <p>The protocol restricted non-urgent bedside care from 00:00 to 03:59. Patients were assigned to usual care ($n = 30$) or the sleep protocol ($n = 26$).</p> <p>The primary outcomes were measures of in-room activity, sound and light. These three types of disturbance were compared between arms during a baseline time block (20:00–23:59) and a rest time block (00:00–03:59).</p>	<p>Usual care and sleep protocol patients had equivalent levels of in-room activity, sound and light during the baseline time block (20:00–23:59).</p> <p>During the rest time block (00:00–03:59), the sleep protocol arm had 32% fewer room entries (relative ratio (RR) 0.68, $p = 0.001$) and 9.1 fewer minutes of in-room activity ($p = 0.0002$). Also, the length of time between room entrances increased from 26.4 to 45.8 min ($p = 0.0004$). The sleep protocol arm also had lower sound during the rest time block. Mean A-weighted sound was 2.5 decibels lower ($p = 0.02$), and there were 36% fewer peaks (RR 0.64, $p = 0.02$). Light levels were highly variable and not changed by the sleep protocol.</p>	<p>No direct correlation with delirium. Protocol measured level of in-room activity and sound levels, which affect the quality of sleep.</p>	<p>Limit non-urgent bedside care between 0000-0359 in addition to hospital-wide quiet protocol with dimmed hallway light, limited overhead page, earplugs, eye mask and television headphones.</p>	<p>III</p>

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Litton, E., Carnegie, V., Elliott, R., & Webb, S. A. (2016). The efficacy of earplugs as a sleep hygiene strategy for reducing delirium in the ICU: A systematic review and meta-analysis. <i>Critical Care Medicine</i>, 44(5), 992–999.</p> <p>Pub Med</p>	<p>To assess the efficacy of earplugs as an ICU strategy for reducing delirium.</p>	<p>Nine studies published between 2009 and 2015, including 1,455 participants, fulfilled the eligibility criteria and were included in the systematic review.</p> <p>Studies included earplugs as an isolated intervention (n = 3), or as part of a bundle with eye shades (n = 2), or earplugs, eye shades, and additional sleep noise abatement strategies (n = 4). The risk of bias was high for all studies.</p>	<p>Systematic review and meta-analysis</p> <p>Independent variable: earplugs</p> <p>Dependent variable: hospital length of stay, ICU and hospital mortality, sleep quality, earplug safety, cost, and incidence of delirium</p>	<p>Earplug placement was associated with a relative risk of delirium of 0.59 (95% CI, 0.44-0.78) and no significant heterogeneity between the studies (I, 39%; p = 0.16).</p> <p>Hospital mortality was reported in four studies (n = 481) and was associated with a relative risk of 0.77 (95% CI, 0.54-1.11; I, 0%; p < 0.001).</p> <p>Compliance with the placement of earplugs was reported in six studies (n = 681).</p> <p>The mean per-patient noncompliance was 13.1% (95% CI, 7.8-25.4) of those assigned to receive earplugs.</p>	<p>The potential effect of cointerventions and the optimal strategy for improving sleep hygiene and associated effect on patient-centered outcomes remains uncertain.</p>	<p>Placement of earplugs in patients admitted to the ICU, either in isolation or as part of a bundle of sleep hygiene improvement, is associated with a significant reduction in risk of delirium.</p>	<p>I</p>

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Locihová, H., Axmann, K., Padyšáková, H., & Fejfar, J. (2018). Effect of the use of earplugs and eye mask on the quality of sleep in intensive care patients: A systematic review. <i>Journal of Sleep research</i>, 27(3), e12607. https://doi.org/10.1111/jsr.12607</p> <p>PubMed</p>	<p>To present a review of recent literature focused on chosen types of nonpharmacological interventions (earplugs and eyemask) analyzing their effect on sleep quality/quantity.</p>	<p>Total 1379 participants ICU and non-ICU patients from 19 studies from USA, China, Iran, Britain, Belgium, France, India</p>	<p>Systematic Review and Meta-analyses</p> <p>Pittsburgh Sleep Quality Index (PSQI) Richards Campbell Sleep Questionnaire (RCSQ) Verran and Snyder's Halpern Sleep Scale (VHS) Polysomnography (PSG) Actigraphy (ACT) Bispectral index (BIS)</p>	<p>Effect of earplugs, eye mask, melatonin was evaluated separately or combined using Rapid Eye Movement (REM) latency, REM phase proportion, melatonin metabolite, Sleep onset latency, number of awakenings, sleep arousal index, melatonin level, self-assessment of sleep quality by the original method (SAI) score, anxiety score, PSQI score, Sleep quality score, Sleep quantity score, levels of 6-SMT and cortisol in urine, RCSQ score, ACT, Spiegel score</p>	<p>Differences in quality sleep assessment methodology in individual studies do not allow for a full comparative systematic statistical meta-analysis.</p>	<p>Earplugs and eye mask showed potential positive effects on sleep quality and the incidence of delirium in the ICU patients</p>	<p>I</p>

Citation / Search Engine	Purpose/ Objectives	population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Patel, J., Baldwin, J., Bunting, P., & Laha, S. (2014). The effect of a multi-component multidisciplinary bundle of interventions on sleep and delirium in medical and surgical intensive care patients. <i>Anesthesia</i>, 69(6), 540–549. https://doi.org/10.1111/anae.12638</p> <p>PubMed</p>	<p>To investigate whether the implementation of a bundle of nonpharmacological interventions, consisting of environmental noise and light reduction designed to reduce disturbing patients during the night, was associated with improved sleep and a reduced incidence of delirium.</p>	<p>167 patients for pre-intervention, 171 patients for post-intervention</p> <p>24 bed adult mixed surgical/medical ICU in a teaching hospital</p>	<p>Pre and Post test design Cohort based study</p> <p>Inclusion criteria Patient > 18 years of age Patient spending one or more nights on the ICU</p> <p>Exclusion criteria Pre-existing history of sleep pathology, severe visual or hearing impairment, alcohol addiction or illicit drug abuse History of cognitive dysfunction (defined as the presence or history of dementia, traumatic brain injury, stroke or hepatic encephalopathy) Previously discharged from the ICU in this hospital admission Neurosurgical patients Developed delirium at any point during the study (defined as a single positive result on the Confusion Assessment Method for the ICU) Received sedative medications within 24 h</p>	<p>An increased mean (SD) sleep efficiency index (60.8 (3.5) before vs 75.9 (2.2) after, $p = 0.031$); reduced mean sound (68.8 (4.2) dB before vs 61.8 (9.1) dB after, $p = 0.002$) and light levels (594 (88.2) lux before vs 301 (53.5) lux after, $p = 0.003$); and reduced number of awakenings caused by care activities overnight (11.0 (1.1) before vs 9.0 (1.2) after, $p = 0.003$). In addition, the introduction of the care bundle led to a reduced incidence of delirium (55/167 (33%) before vs 24/171 (14%) after, $p < 0.001$), and less time spent in delirium (3.4 (1.4) days before vs 1.2 (0.9) days after, $p = 0.021$). Increases in sleep efficiency index were associated with a lower odds ratio (OR) of developing delirium (OR 0.90, 95% CI 0.84-0.97).</p>	<p>The introduction of an environmental noise and light reduction program as a bundle of nonpharmacological interventions in the intensive care unit was effective in reducing sleep deprivation and delirium.</p>	<ul style="list-style-type: none"> -Close all doors -Turn monitoring equipment to night mode (23:00-07:00) -Reduce volumes on all telephones (2300-0700) -No non-clinical discussions around patients' bed spaces -Staff and visitors to speak quietly -Offer earplugs to all patients with RASS>4 -Dim main ICU lights (2300-0700) -Use bedside lighting for patient care -Offer eye masks to all patients with RASS>4 -Group care/procedures before 23:00 or delay their completion until after 08:00 -Orientate patients regarding time, place, date every eight hours -If patients sleep poorly or have a positive result on the Confusion Assessment Method for the Intensive Care Unit, perform a medication review within 24 h -Set appropriate sedation targets once per day (RASS) - SAT and SBT -Hourly pain scores & prompt action -Ensure early mobilization 	<p>III</p>

Citation / Search Engine	Purpose/ Objectives	population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Pisani, M. A., & D'Ambrosio, C. (2020). Sleep and delirium in adults who are critically ill: A contemporary review. <i>Chest</i>, 157(4), 977–984. https://doi.org/10.1016/j.chest.2019.12.003</p> <p>PubMed</p>	<p>To review the literature on sleep in critical illness and the potential mechanisms and pathways that may connect sleep and delirium.</p>	<p>Critically ill patients in the ICU</p>	<p>Literature review</p>	<p>Sleep disruption in the ICU – prolonged sleep latency, sleep fragmentation, and numerous arousals.</p> <p>Barriers to sleep in ICU – noise (average noise level 55 to 65 dB, recommendation: 45 dB during day 35 dB at night)</p> <ul style="list-style-type: none"> - patient care activities - ambient lighting - mechanical ventilation - Host related: pain, anxiety, pre-existing conditions - Medications – benzodiazepines, Propofol, opiates 	<p>Strategies to improve sleep – multifactorial and coordinated bundled care</p>	<ul style="list-style-type: none"> - Sound reduction (eg, ear plugs, alarms silenced in room) -Reduction of bright lights during typical sleep hours (eg, offset lighting rather than overhead, reduced intensity, sleep mask) - Limitation of interruptions during typical sleep hours -Daytime mobility and attempts at maintaining alertness when appropriate -Relaxation techniques (eg, massage, reiki) 	<p>VII</p>

Citation / Search Engine	Purpose/ Objectives	population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Pun, B. T., Balas, M. C., Barnes-Daly, M. A., Thompson, J. L., Aldrich, J. M., Barr, J., Byrum, D., Carson, S. S., Devlin, J. W., Engel, H. J., Esbrook, C. L., Hargett, K. D., Harmon, L., Hielsberg, C., Jackson, J. C., Kelly, T. L., Kumar, V., Millner, L., Morse, A., Perme, C. S., ... Ely, E. W. (2019). Caring for critically ill patients with the ABCDEF bundle: results of the ICU liberation collaborative in over 15,000 adults. <i>Critical Care Medicine</i>, 47(1), 3–14.</p> <p>https://doi.org/10.1097/CCM.00000000000003482</p> <p>PubMed</p>	<p>To evaluate the relationship between ABCDEF bundle performance and patient-centered outcomes in critical care</p>	<p>- Patients: 15,226 adults with at least one ICU day.</p> <p>- Inclusion criteria: adult patients, on or off mechanical ventilation, admitted to a participating medical, surgical cardiac, or neurological ICU</p> <p>- Exclusion criteria: patients who died or were discharged from the participating ICU within 24 hours of ICU admission or were undergoing active life support withdrawal and/or “comfort care-only” within 24 hrs of ICU admission</p> <p>- Setting: 68 academic, community, and federal ICUs in the US</p> <p>- Data collected during a 20-month period</p>	<p>Prospective, multicenter, cohort study from a national quality improvement collaborative</p> <p>Pain was measured with Pain numeric rating scale score, Behavioral Pain Score, Critical Care Pain Observation Tool (CPOT).</p>	<p>Complete ABCDEF bundle performance was associated with lower likelihood of seven outcomes:</p> <ul style="list-style-type: none"> - hospital death within 7 days (adjusted hazard ratio, 0.32; CI, 0.17–0.62) - next-day mechanical ventilation (adjusted odds ratio [AOR], 0.28; CI, 0.22–0.36), - coma (AOR, 0.35; CI, 0.22–0.56), - delirium (AOR, 0.60; CI, 0.49–0.72), - physical restraint use (AOR, 0.37; CI, 0.30–0.46), - ICU readmission (AOR, 0.54; CI, 0.37–0.79), and - discharge to a facility other than home (AOR, 0.64; CI, 0.51–0.80). 	<p>Limitations – not randomized, possibility of reporting bias</p> <p>Although the paper is not specifically on nonpharmacological interventions, most of the bundle consists of nonpharmacological interventions.</p>	<p>ABCDEF bundle performance showed significant and clinically meaningful improvements in outcomes including survival, mechanical ventilation use, coma and delirium, restraint-free care, ICU re-admissions, and post-ICU discharge disposition</p>	<p>IV</p>

Citation / Search Engine	Purpose/ Objectives	Population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Rudolph, J. L., Archambault, E., Kelly, B., & VA Boston Delirium Task Force (2014). A delirium risk modification program is associated with hospital outcomes. <i>Journal of the American Medical Directors Association</i>, 15(12), . https://doi.org/10.1016/j.jamda.2014.08.009</p>	<p>To develop and implement a sustainable program that mitigates delirium risk and demonstrates improved patient outcomes (lower restraint use and discharge to rehabilitation), while building a business case (decreased length of stay and variable direct cost) for medical center leadership.</p>	<p>The 125-bed tertiary referral Veterans Affairs medical center for New England. Veterans, 65 years of age and older, admitted to an acute care medical ward <i>N</i> = 1527 No intervention <i>n</i> = 818 Delirium toolbox intervention <i>n</i> = 709</p>	<p>Quasi-experimental design Outcomes (length of stay, restraint use, rehabilitation discharge, and cost) were compared using a propensity-matched cohort of patients without intervention The Delirium Toolbox includes items to (1) correct sensory input, (2) stimulate cognition, and (3) promote sleep</p>	<p>Patients with interventions were discharged to rehabilitation similarly (mean difference [MD] 2.2%, 95% CI 2.56.9) and had lower lengths of stay (MD 0.7 day, 95% CI 1.3 to 0.1), lower restraint use (MD 4.0%, 95% CI 6.7 to1.2) and trended toward lower variable direct costs (MD\$1390, 95% CI3586807). Increasing number of interventions was associated with shorter length of stay, lower rate of restraint use, and lower variable direct costs.</p>	<p>The interventions include two other categories (Correct sensory input and stimulate cognition) in addition to the topic of this paper (promote sleep).</p>	<p>Earplugs Eye masks Headphones</p>	<p>III</p>

Citation / Search Engine	Purpose/ Objectives	population/ Sample/ Setting	Design/Methods/ Variables/Instruments	Result(s)/ Main Findings	Implications /critique	Comments Themes	Level of Evidence
<p>Tembo, A. C., Parker, V., & Higgins, I. (2013). The experience of sleep deprivation in intensive care patients: findings from a larger hermeneutic phenomenological study. <i>Intensive & Critical Care nursing</i>, 29(6), 310–316. https://doi.org/10.1016/j.iccn.2013.05.003</p>	<p>To describe the experience of critical illness in ICU with DSI and how this impacted the participants' continued existence</p>	<p>A 22 bed ICU of a tertiary referral teaching hospital in the state of New South Wales (NSW) in Australia, Twelve participants aged between 20 and 76 years with an ICU stay ranging from three to 36 days were recruited from a 16 bed ICU in a large regional referral hospital in New South Wales (NSW), Australia. Participants were intubated, mechanically ventilated and subjected to daily sedation interruption during their critical illness in ICU.</p>	<p>A qualitative design guided by phenomenology as the research methodology. In-depth face to face interviews with the participants were conducted at two weeks after discharge from ICU. A second interview was conducted with eight participants six to eleven months later. Interviews were audio taped and transcribed. Data were analyzed thematically</p>	<p>The common themes for the main findings are “Longing for normal sleep” and ‘Being tormented by nightmares’.</p>	<p>A need for models of care that seek to support restful sleep and prevent or alleviate sleep deprivation and nightmares.</p>	<p>Experiences of sleep deprivation, nightmare, and desperation for normal sleep</p>	<p>VI</p>

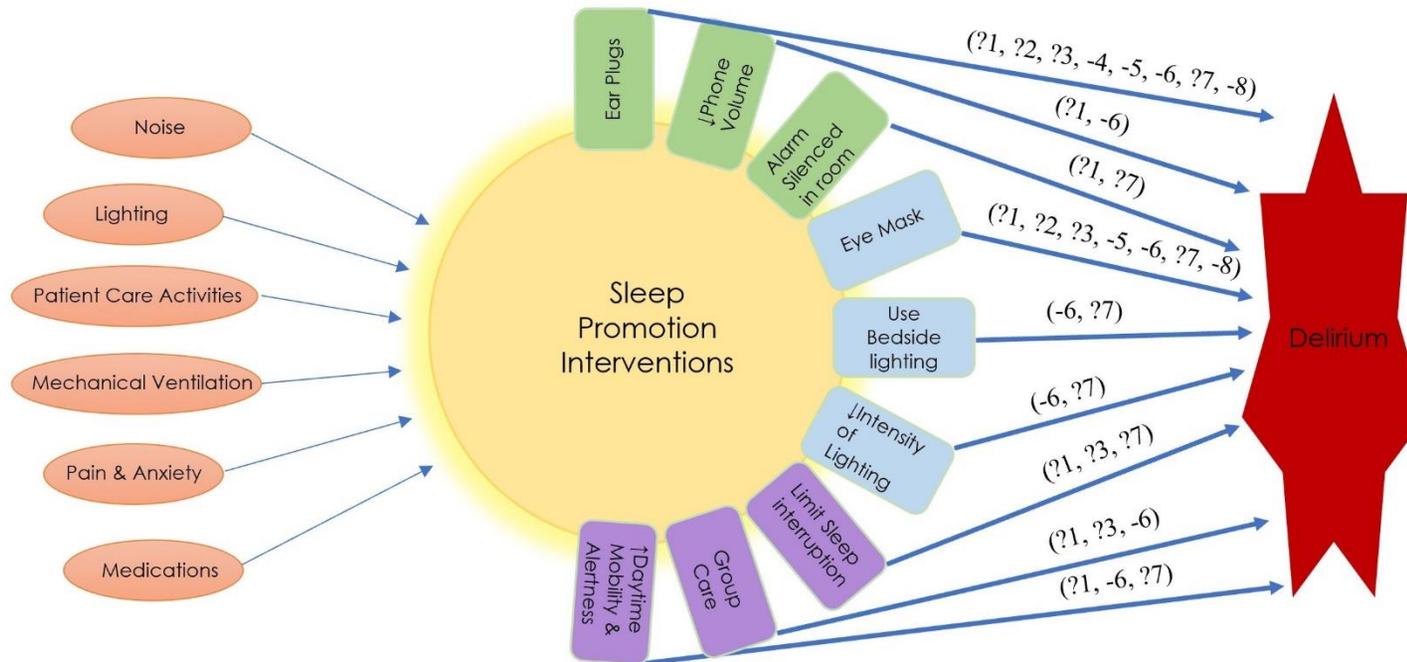
Table 2*Levels of Evidence Table*

Level of evidence (LOE)	Description
Level I	Evidence from a systematic review or meta-analysis of all relevant RCTs (randomized controlled trial) or evidence-based clinical practice guidelines based on systematic reviews of RCTs or three or more RCTs of good quality that have similar results.
Level II	Evidence obtained from at least one well-designed RCT (e.g. large multi-site RCT).
Level III	Evidence obtained from well-designed controlled trials without randomization (i.e. quasi-experimental).
Level IV	Evidence from well-designed case-control or cohort studies.
Level V	Evidence from systematic reviews of descriptive and qualitative studies (meta-synthesis).
Level VI	Evidence from a single descriptive or qualitative study.
Level VII	Evidence from the opinion of authorities and/or reports of expert committees.

This level of effectiveness rating scheme is based on the following: Ackley, B. J., Swan, B. A., Ladwig, G., & Tucker, S. (2008). *Evidence-based nursing care guidelines: Medical-surgical interventions*. (p. 7). St. Louis, MO: Mosby Elsevier.

Figure 1

Conceptual Map of Research Literature Reviewed



KEY

1. Beck Edvardsen, J., & Hetmann, F. (2020).
2. Devlin, J. W et al. (2018).
3. Knauert, M. P., Pisani, M., Redeker, N., Murphy, T., Araujo, K., Jeon, S., & Yaggi, H. (2019).
4. Litton, E., Carnegie, V., Elliott, R., & Webb, S. A. (2016).
5. Locihová, H., Axmann, K., Padyšáková, H., & Fejfar, J. (2018).
6. Patel, J., Baldwin, J., Bunting, P., & Laha, S. (2014).
7. Pisani, M. A., & D'Ambrosio, C. (2020).
8. Rudolph, J. L., Archambault, E., Kelly, B., & VA Boston Delirium Task Force (2014).

 Antecedents	 Concept	 Consequences
 Noise Reduction	 Light Reduction	 Patient Care Adjustment

+	Positive Relationship
?	Neutral or No Relationship
-	Negative Relationship

Appendix A

AGREE II Score Sheet: The Appraisal of Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption in Adult Patients in the ICU (Devlin et al.,2018)

Reviewed by Jimy Chun, Jacob Forsythe, Sarah Lee and Sarah Peabody

Domain	Item	AGREE II Rating						
		1 <small>Strongly Disagree</small>	2	3	4	5	6	7 <small>Strongly Agree</small>
1. Scope and purpose	<p>1. The overall objective(s) of the guideline is (are) specifically described.</p> <p>Comments: The overall objectives are well written, clear and concise.</p> <ul style="list-style-type: none"> • To provide updated recommendations in the 2013 Clinical Practice Guideline for Management of Pain, Agitation, and Delirium in Adult Patients in the ICU. • To provide current studies that affects pain such as rehabilitation/ mobilization and Sleep (disruption) in management of pain. • To include patients as collaborators and coauthors of the new updated guideline. • To invite international panel of experts from high income countries as an early step toward incorporating more diverse practices and expertise from global critical care community. 							X
	<p>2. The health question(s) covered by the guideline is (are) specifically described.</p> <p>Comments: The guideline provides a detailed descriptions of health questions in every domain/ recommendation. Target population, intervention and outcomes are included in the health questions. It is well written, clear and concise. Following examples:</p> <ul style="list-style-type: none"> • What factors influence pain in critically ill adults during both rest and during procedures? • What are the most reliable and valid pain assessment methods to use in critically ill adults? • Should acetaminophen be used as an adjunct to an opioid (vs an opioid alone) for pain management in critically ill adults? • Should an NSAID administered IV, orally, and/or rectally (vs an opioid) be used for critically ill adults undergoing a procedure? 							X

	<ul style="list-style-type: none"> Should cold therapy (vs no use of cold therapy) be used for critically ill adults undergoing a procedure? 							
	<p>3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.</p> <p>Comment: The guideline includes clear description of the target population. It is concise and easy to find. However, it lacks the definition of “adult” in terms of age. For example:</p> <ul style="list-style-type: none"> A guideline for management of Pain, Agitation, and Delirium in Adult Patients in the ICU. 							X
2. Stakeholder involvement	<p>4. The guideline development group includes individuals from all the relevant professional groups.</p> <p>Comment: Within the second page of the article, it listed the authors name, their credentials, institutions and their relevant expertise of the guideline development. Members of the group were relevant clinicians, researchers, medical librarian, methodologist and critical illness survivors. In the “Supplemental Appendix 1”, it shows how 50% of the members came from 2013 guideline member panels and the other 50% of the members are new with the aim to represent the multidisciplinary professionals relevant to ICU practice.</p>							X
	<p>5. The views and preferences of the target population (patients, public, etc.) have been sought.</p> <p>Comment: The item is well written and easy to find. In the Method section, it was stated that the ICU survivors participated through an online survey called Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidance to helped prioritize selected topics, questions and outcomes. Each member ranks the topics with a score from 1 (very low importance) to 5 (very high importance). After every member in the guideline discussed the topic ranking, ICU survivors are were encouraged to provide their input in a patient perspective. In the “Supplemental Appendix 1”, there is a full description of how the information were gathered and was used to inform the guideline development.</p>							X

	<p>6. The target users of the guideline are clearly defined.</p> <p>Comment: The target/intended users are clearly defined as Advanced Practice Nurses, Allied Health Personnel, Health Care Providers, Nurses, Patients, Physicians, Physical Assistants, and Physicians. It further lists the clinical specialties involved in the use of this guideline.</p>								X
3. Rigor of development	<p>7. Systematic methods were used to search for evidence.</p> <p>Comment: Names of electronic databases (PubMed, EMBASE, Cochrane Database, CINAHL, & Web of Science), time periods searched (1990 to present) and the search terms used are included in the supplement Appendix 1 with the web link. The search strategy is outlined in Supplemental Table 5.</p>								X
	<p>8. The criteria for selecting the evidence are clearly described.</p> <p>Comment: The target population characteristics are clearly described as adult ICU patients. Rationales were provided with outcomes from previous studies. There was no limitation on language. Inclusion and exclusion criteria were stated in some studies and rationale, but rationales for each recommendation were provided with evidences.</p>								X
	<p>9. The strengths and limitations of the body of evidence are clearly described.</p> <p>Comment: Overall limitations were discussed in the summary section, and the descriptions are clear. Study designs were included in body of evidence (RCTs - double blind or single blind, etc.). Study methodology limitations such as small sample size and limited staff training were identified. It is clearly stated that the five topics are interrelated. Charts or tables of evidence were included in the supplemental materials. The recommendations to use the interventions were made only for the area where the results across studies were consistent. Magnitudes of benefit versus harm were discussed and the recommendations were made accordingly. Applicability to practice context such as music therapy and hypnosis were included.</p>							X	

<p>10. The methods for formulating the recommendations are clearly described.</p> <p>Comment: Recommendation development process was clearly described as voting procedure, and the outcomes were included in the supplemental table. On studies with a low-quality evidence, the high risk of bias, and low feasibility to implement, the panel issued recommendation against the interventions.</p>								X
<p>11. The health benefits, side effects and risks have been considered in formulating the recommendations.</p> <p>Comment: Explicit supporting data of benefits and risks were provided for each topic. Recommendations reflect considerations of both benefits and side effects explaining the trade-offs between benefits and risks.</p>								X
<p>12. There is an explicit link between the recommendations and the supporting evidence.</p> <p>Comment: The guideline clearly provides recommendations and rationales for each recommendation. The links to the supporting data such as the evidence summaries and evidence-to decision tables are provided as supplemental contents.</p>								X
<p>13. The guideline has been externally reviewed by experts prior to its publication.</p> <p>Comment: The purpose and intent of the external review was not given. The only subject specifically mentioned was the feasibility of implementation of the guideline. There is a description of the type of methods given but has little detail. Outcomes and information gathered from external reviews is not given. It is stated that all available information was used to build consensus in the task force, but not what had influence.</p>	X							
<p>14. A procedure for updating the guideline is provided.</p>	X							

	<p>Comment: No procedural method or timeline for updating guideline is provided. No information on when an update will occur or what criteria would trigger an update.</p>							
4. Clarity of presentation	<p>15. The recommendations are specific and unambiguous. Comment: The recommendations and rationales are generally clear. The rationales for 37 graded recommendations, two ungraded good practice statements, and 32 ungraded statements are clearly stated across the five guideline sections. For example, a specific question of Ketamine for pain management was provided with the recommendation and rationale followed by, “We suggest using low-dose ketamine (0.5 mg/kg IVP x 1 followed by 1-2 µg/kg/min infusion)” (p. e831). They should give instructions on how to read the recommendations and suggestions in the beginning in the method section instead of following the link (appendix). They should include a table of contents in the beginning.</p>						X	
	<p>16. The different options for management of the condition or health issue are clearly presented. Comment: Yes. If there were no clear recommendations or other alternative options for a specific health issue, then panels would provide a few suggestions. For example, for the nonpharmacological intervention to reduce pain, the panels suggest alternatives such as music therapy or relaxation techniques instead of hypnosis (not recommended).</p>							X
	<p>17. Key recommendations are easily identifiable. Comment: Overall, the key recommendations are easy to identify in the guideline. There are leading questions followed by recommendation. However, the panels do not include a key recommendation for some ungraded statements such as physiologic measures for the pain assessment. It is clearly stated “not valid indicators for pain in critically ill adults and should only be used as cues” (p. 830).</p>							X
5. Applicability	<p>18. The guideline describes facilitators and barriers to its application. Comment: The panels describe that this guideline is derived from suggestions and data many</p>						X	

	<p>international groups, clinicians, stakeholders, and decision makers to foster the application and quality of care in clinically ill ICU patients. However, the barriers they mentioned are valid unknown factors which could influence the evidence.</p>							
	<p>19. The guideline provides advice and/or tools on how the recommendations can be put into practice.</p> <p>Comment: No clinical algorithm is identified. There is no specific strategy to apply this into practice. However, tables and resources are described in the guideline and in the links of supplemental items. However, panels were unsure of the utilization of other educational purposes of this guideline. It suggests that the limitations of different dissemination methods and approaches be addressed in a separate publication for educational programs and for quality improvement initiatives (p. e860).</p>						X	
	<p>20. The potential resource implications of applying the recommendations have been considered.</p> <p>Comment: No details of costs, staff, or budgetary analysis were presented in the guideline. For example, when the researchers were asked about using physiologic sleep monitoring, the guideline was not recommended because of limited evidence, time, and the equipment necessary to check this kind of study. However, the panels explain other resources from similar studies such Richards Campbell Sleep questionnaire and informal subjective bedside assessment for sleep monitoring (p. e855). Resources including the contributors of 2013 and ICU survivors' patients were also involved to develop this guideline.</p>							X
	<p>21. The guideline presents monitoring and/or auditing criteria.</p> <p>Comment: There are no clear criteria provided in this guideline which include process measures. The only criteria found is in the criteria summary, a specific section labeled, "Starting and Stopping Physical Rehabilitation or Mobilization Performed Either In-Bed or Out-of-Bed" (p.e851). The other criteria they used was assessing the GRADE approach in the certainty of evidence section (supplemental table 3).</p>						X	

Editorial independence	<p>22. The views of the funding body have not influenced the content of the guideline.</p> <p>Comment: Funding was not discussed in the Guideline, nor was the funding body/views. Members with financial or intellectual conflict of interest did not review questions related to their conflict. All five groups' comments were recommendations were screened for potential and perceived conflict.</p>							X
	<p>23. Competing interests of guideline development group members have been recorded and addressed.</p> <p>Comment: Members completed and submitted a SCCM conflict of interest form at least annually, disclosing whether there were potential financial conflicts. Members attending meetings were asked to report any new conflicts of interest. If so, the member filed an updated conflict of interest form. Voting and primary reviewing members who had conflicts of interest, including those receiving funding r/t evidence supporting a question, and interest in a specific guideline, were required to abstain from voting on those questions/guidelines (supplemental table 1).</p>							X
Overall Guideline Assessment	<p>1. Rate the overall quality of this guideline.</p> <p>See Appendix A</p>	1 <i>Lowest possible quality</i>	2	3	4	5	6	7 <i>Highest possible quality</i>
Overall Guideline Assessment	<p>2. I would recommend this guideline for use, with modifications.</p> <ul style="list-style-type: none"> • Purpose and intent of external review was not well defined. • Procedural methods and a timeline were not included. • Providing an index at the beginning of the guideline would be beneficial to help guide the reader through the extensive amount of information presented. • Clinical algorithm and details of costs, staff, or budgetary concerns are should be listed and easy to find. 	<i>Yes</i>		<i>Yes, with modifications</i>			<i>No</i>	
				X				

Appendix B

Joanna Briggs Institute Critical Appraisal Checklist for Systematic Reviews and Research

Syntheses

Citation: Beck Edvardsen, J., & Hetmann, F. (2020). Promoting sleep in the intensive care Unit. <i>SAGE Open Nursing</i> , 6, 2377960820930209. https://doi.org/10.1177/2377960820930209				
	Yes	No	Un-clear	Not Applic-able
1. Is the review quest clearly and explicitly stated? “to develop an evidence-based bundle of nursing care activities”	X			
2. Were the inclusion criteria appropriate for the review question?	X			
3. Was the search strategy appropriate?	X			
4. Were the sources and resources used to search for studies adequate?	X			
5. Were the criteria for appraising studies appropriate?	X			
6. Was critical appraisal conducted by two or more reviewers independently?			X	
7. Were there methods to minimize errors in data extraction?		X		
8. Were the methods used to combine studies appropriate?		X		
9. Was the likelihood of publication bias assessed?		X		
10. Were recommendations for policy and/or practice supported by the reported data?	X			
11. Were the specific directives for new search appropriate?	X			
Overall appraisal	Include (O)	Exclude ()	Seek further info ()	
Comments (including reason for exclusion) This systematic review made recommendations on eight nursing care activities based on 22 articles. The quality and validity of each study was determined using The Norwegian Knowledge Centre for the Health Services checklist, and the strength of the recommendations were evaluated using GRADE. No statistical analysis on results such as OR, RR, effect size or CI. Strong recommendation on noise reduction, and weak recommendations on the rest of the interventions. No data on the relationship between the interventions and delirium.				

Citation: Litton, E., Carnegie, V., Elliott, R., & Webb, S. A. (2016). The efficacy of earplugs as a sleep hygiene strategy for reducing delirium in the ICU: A systematic review and meta-analysis. <i>Critical Care Medicine</i> , 44(5), 992–999. https://doi.org/10.1097/CCM.0000000000001557				
	Yes	No	Un-clear	Not Applic-able
1. Is the review quest clearly and explicitly stated?	X			
2. Were the inclusion criteria appropriate for the review question?	X			
3. Was the search strategy appropriate?	X			
4. Were the sources and resources used to search for studies adequate?	X			
5. Were the criteria for appraising studies appropriate?	X			
6. Was critical appraisal conducted by two or more reviewers independently?	X			
7. Were there methods to minimize errors in data extraction?	X			
8. Were the methods used to combine studies appropriate?	X			
9. Was the likelihood of publication bias assessed?	X			
10. Were recommendations for policy and/or practice supported by the reported data?	X			
11. Were the specific directives for new search appropriate?	X			
Overall appraisal	Include (X)	Exclude	Seek further info	
Comments (including reason for exclusion) This study reviewed and analyzed the efficacy of earplugs as a single intervention or part of a bundle for reducing delirium using five RCTs and 4 non-randomized, interventional studies. The authors utilized RR, CI, heterogeneity, sensitivity analysis, and tools such as the funnel plot to assess the risk of bias to provide information on reliability. High efficacy of earplugs in reducing delirium, no difference in hospital mortality. Studies were small, single center studies with a high risk of bias.				

Citation: Locihová, H., Axmann, K., Padyšáková, H., & Fejfar, J. (2018). Effect of the use of earplugs and eye mask on the quality of sleep in intensive care patients: A systematic review. <i>Journal of Sleep Research</i> , 27(3), e12607. https://doi.org/10.1111/jsr.12607				
	Yes	No	Un-clear	Not Applic-able
1. Is the review quest clearly and explicitly stated?	X			
2. Were the inclusion criteria appropriate for the review question?		X		
3. Was the search strategy appropriate?	X			
4. Were the sources and resources used to search for studies adequate?	X			
5. Were the criteria for appraising studies appropriate?	X			
6. Was critical appraisal conducted by two or more reviewers independently?			X	
7. Were there methods to minimize errors in data extraction?		X		
8. Were the methods used to combine studies appropriate?		X		
9. Was the likelihood of publication bias assessed?		X		
10. Were recommendations for policy and/or practice supported by the reported data?		X		
11. Were the specific directives for new search appropriate?		X		
Overall appraisal	Include	Exclude	Seek further info (X)	
<p>Comments (including reason for exclusion)</p> <p>This paper claims as a systematic review, but it rather summarizes the articles rather than synthesizing and appraising. The inclusion criteria listed (time frame of 1990-2015 and full text) did not match any elements of the research question. The clinical question of “to confirm whether selected nonpharmacological interventions (earplus, eyemasks) have a positive effect on the quality of sleep in ICU patients” is not clearly answered (p2). The author did include three studies (two RCTs and a pre-post study) that have significant reduction on incidence of delirium but specified the interventions in only one study. There was no discussion on the methods to minimize errors in data extraction or assessment of the likelihood of publication bias. The recommendation for nursing practice for sleep-promoting strategies contained alternative and complementary practices and did not support the study findings.</p>				