DO EARPLUGS AND EYE MASKS AFFECT SLEEP AND DELIRIUM OUTCOMES IN THE CRITICALLY ILL?

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Humans use their senses to evaluate situations in which they find themselves. From birth and beyond, optimal survival requires accurate interpretation of senses of taste, touch, smell, sight, and sound. Hearing ranks as the most important sense after sight. Critically ill adults are vulnerable when admitted to the intensive care unit (ICU) because patients are bombarded with unfamiliar sounds, bright lights, and interruptions, creating a potentially hostile environment.

Imagine waking up to the sounds of a bedside computer keeping track of blood pressure, heart rate, and respiratory rate or oxygen saturation; mechanical ventilation; continuous lateral rotation; feeding pumps; external pneumatic compressions devices; medication pumps and a continuous Yankauer suction setup tucked under a pillow. Then consider audible alarms from any 1 or 2 of those technical devices. Now interpret those sounds accurately. And by the way, the 10-member multidisciplinary team is rounding in the hallway just outside your room. Several loud voices are heard discussing medication profiles and treatment plans. Interpret those sounds as well.

Noisy ICUs and bright lights are undesirable because evidence shows that such stimuli can cause both psychological and physiologic harm in an environment otherwise focused on recovery and healing. Negative psychological states such as agitation, confusion, and delirium follow the stimuli of sleep-interrupting noises or bright lights. The incidence of ICU-acquired delirium has been reported to be as low as 20% and as high as 80%. A continuously noisy atmosphere as just described can cause physiologic harm with cardiovascular stimulation and suppression of immune response to infection. ICU patients already in septic shock or recovering from massive or acute myocardial infarction do not need increased demands on cardiovascular or immune systems. Undesirable consequences follow sensory overload, especially in critically ill adults.

Instead of getting quieter, ICUs may in fact be getting noisier over time. Experts report that sound levels or decibels (dB) all exceed recommended levels for hospital care. Interest in reducing noise in ICUs is growing. Several teams are studying ways to reduce or eliminate unwanted or unnecessary noise to improve patients’ outcomes. Thus, the PICO (patient/problem, intervention, comparison, outcomes) question that this review addresses is, What effect do the interventions of earplugs and eye masks have on sleep and delirium outcomes in critically ill adults?

Method

The strategy included searching CINAHL and MEDLINE. Key words included earplugs, eye masks, sleep quality, sleep deprivation, sensory overload, and delirium. The search was limited to original research studies.

Results

Table 1 outlines the major findings of the 7 studies retrieved. Half of the studies assessed the effect of using the earplug or eyemask intervention for only 1 night, whereas the others evaluated use for up to 5 nights. Sleep was predominantly measured through self-report of sleep quality/quantity, as well as factors that prevented and promoted

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One investigation used the Verran-Synder-Halpern Sleep Scale,\textsuperscript{12} whereas others used the Richards-Campbell Sleep Questionnaire\textsuperscript{10} or the Sleep Assessment Tool,\textsuperscript{13} the latter of which has no reported psychometrics. One study measured sleep variables objectively by using polysomnography in a simulated critical care environment.\textsuperscript{8} Delirium was examined in 2 studies with the Neecham or Confusion-Assessment Method-ICU (CAM-ICU)\textsuperscript{10} tool. In 3 studies, the comfort of earplugs and eye masks was evaluated to assess the feasibility of the interventions.\textsuperscript{9,11,13}

**Recommendations for Practice**

Although most evidence for this intervention is level B/C evidence (Table 2), the findings of the studies included in this review were inconclusive. The

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**Table 1**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Design, intervention, and sample size</th>
<th>Intervention effects\textsuperscript{a}</th>
<th>Sleep outcomes</th>
<th>Delirium</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wallace et al\textsuperscript{8}</td>
<td>Repeated-measures experimental (randomized) • Earplugs • Healthy volunteers in simulated intensive care unit sample (N = 6)</td>
<td>+: Rapid-eye-movement (REM) latency +: Percentage of REM sleep +: Sleep maintenance efficiency index (ratio of total sleep time to time in bed minus time required to fall asleep)</td>
<td></td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Hu et al\textsuperscript{9}</td>
<td>Repeated-measures experimental (randomized) • Earplugs and eye masks • Healthy persons in simulated intensive care unit (N = 14)</td>
<td>+: Improved REM sleep +: Shorter REM latency +: Fewer arousals +: Elevation of nocturnal melatonin levels</td>
<td></td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Kamdar et al\textsuperscript{10}</td>
<td>Pre-post test design (nonrandomized) • Earplugs and eye masks • Critically ill adults (N = 15)</td>
<td>0: Sleep quality</td>
<td>0: Cognitive status</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Jones and Dawson\textsuperscript{11}</td>
<td>Pre-post quasi-experimental (nonrandomized) • Earplugs and eye masks • Critically ill adults (N = 100)</td>
<td>0: Sleep quality 0: Sleep quantity</td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Van Rompaey et al\textsuperscript{12}</td>
<td>Randomized controlled trial • Earplugs • Critically ill adults (N = 136)</td>
<td>+: Sleep perception (better sleep after first night) 0: Sleep perception (2nd-4th nights) +: Lower prevalence/severity of delirium +: Delayed onset of cognitive disturbances</td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Scotto et al\textsuperscript{13}</td>
<td>Quasi-experimental (randomized) • Earplugs • Critically ill adults (N = 88)</td>
<td>+: Total sleep scores +: Subjective sleep perceptions: • Fell asleep easier, less waking, tossing, turning • Slept more deeply/for longer periods • Awoke refreshed and more satisfied with quantity of sleep 0: Amount of time to fall asleep</td>
<td></td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Richardson et al\textsuperscript{14}</td>
<td>Post-test quasi-experimental (nonrandomized) • Earplugs and eye masks • Critically ill adults (N = 64)</td>
<td>0: Sleep quality 0: Sleep quantity</td>
<td></td>
<td></td>
<td>C</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Key: + = beneficial impact (P < .05); 0 = no impact (P > .05).
results for the intervention groups showed beneficial impact \( (P < 0.05) \) for increased rapid-eye-movement (REM) sleep and decreased REM latency in 2 of the 6 studies.\(^5\)\(^,\)\(^6\) Results are less compelling, however, because the studies were conducted in a simulated ICU environment with healthy adults and small sample sizes. Interestingly, in one of the simulated critical care environments, the earplug/eye mask intervention showed beneficial impact on an objective marker of sleep with a reported elevation of nocturnal levels of melatonin. A natural hormone produced by the pineal gland, melatonin is released in response to light-dark cycles. Secretion of melatonin increases at night and decreases during daytime hours.\(^5\) Thus, as melatonin levels rise, individuals become less alert and sleepy.

In clinical settings, sleep perception had beneficial results in 2 studies\(^5\)\(^,\)\(^12\) but was limited to the first night only in the intervention group.\(^5\) In these studies, patients reported falling asleep easier, waking less, sleeping longer and deeper, and awaking feeling more refreshed. The other studies\(^11\)\(^,\)\(^13\) in which sleep perception was evaluated showed no positive effect of the interventions \( (P > 0.5) \). Although noted to be statistically significant, the effects of the interventions on delirium were evaluated in only 1 study. In this study, the use of earplugs decreased the risk of delirium or confusion by 50\% (hazard ratio, 0.47; 95\% CI, 0.27-0.82), and was associated with a lower prevalence and severity, as well as later onset, of delirium.\(^5\) Further research would be beneficial to evaluate earplug and eye mask use and their effects on delirium outcomes.

The body of evidence on these interventions could also be supplemented with additional studies conducted in critical care settings with adult patients experiencing actual versus simulated environmental noise. The adverse health effects of sleep disruption are well known and affect both psychological and physiologic well-being.\(^16\) As discussed earlier, disrupted sleep can induce agitation and confusion, cardiovascular stimulation, and immune suppression, thus increasing the patient’s risk for infection or delayed healing, elevated blood pressure, inflammation, and increased need for medications. In a review of 11 noise studies, Xie et al\(^12\) found that noise was the most significant factor for sleep disturbance in almost half of the studies. The most disturbing noise sources were staff conversations and alarms, especially those with high frequencies.

As a result, sound- and light-masking interventions such as earplugs and eye masks are promising noninvasive and low-cost techniques that may improve objective sleep variables, as well as subjective sleep experiences of adults in critical care settings. In a number of studies, the comfort of the interventions was evaluated on the basis of patients’ feedback.\(^5\)\(^,\)\(^11\)\(^,\)\(^13\) Many subjects reported that these interventions were comfortable and tolerable although Richardson et al\(^13\) reported a wide range of experience among critically ill patients. Hu et al\(^5\) used earplugs with a 29-dB noise reduction rating from 3M Corporation and 3 choices of eye masks (product specifications were not identified). Participants evaluated comfort, effectiveness, and ease of use, with overall ratings showing the products were “very comfortable, very helpful and very easy to use.”

Richardson et al\(^13\) reported more varied ratings regarding comfort. These researchers noted that nylon eye masks, in addition to high environmental temperatures, may have decreased tolerance because the masks felt hot and sweaty. Comfort issues with earplugs were noted as ear soreness and plugs falling out. Additional information regarding product comparison and perception of comfort and ease of use would be beneficial to aid in product selection in the clinical environment. Nurses may also assist with comfort by providing accurate instructions for product use, checking for improper insertion or positioning, and assessing patients’ perceived level of anxiety with use of these products.

In addition to earplug and eye-mask interventions, other alterations to practice include lowering voices and closing patients’ doors to decrease conversation-related noise at nursing stations; reducing/eliminating overhead paging; dimming lights and enforcing unit-based quiet times; minimizing unnecessary interruptions and clustering patient care activities; and addressing “squeaky” equipment maintenance in a timely manner. Other environmental enhancements include soundproofing with carpet and ceiling tiles, as well as use of nocturnal

<table>
<thead>
<tr>
<th>Table 2</th>
<th>American Association of Critical-Care Nurses evidence-leveling system(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Description</td>
</tr>
<tr>
<td>A</td>
<td>Meta-analysis of multiple controlled studies or metasynthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment</td>
</tr>
<tr>
<td>B</td>
<td>Well-designed controlled studies, both randomized and non-randomized, with results that consistently support a specific action, intervention, or treatment</td>
</tr>
<tr>
<td>C</td>
<td>Qualitative studies, descriptive or correlational studies, integrative reviews, systematic reviews, or randomized controlled trials with inconsistent results</td>
</tr>
<tr>
<td>D</td>
<td>Peer-reviewed professional organizational standards, with clinical studies to support recommendations</td>
</tr>
<tr>
<td>E</td>
<td>Theory-based evidence from expert opinion or multiple case reports</td>
</tr>
<tr>
<td>M</td>
<td>Manufacturer’s recommendation only</td>
</tr>
</tbody>
</table>

\(^a\)From Armola et al\(^{14}\) with permission.
lighting sources without blue light to maintain circadian light cycles.18-20

Interventions and modifications such as these have the power to transform the ICU from a potentially hostile environment into an optimal healing environment (OHE), a term coined by the Samueli Institute in 2002. OHEs support and stimulate healing by combining a variety of approaches to promote harmony of the mind, body, and spirit.19,21,22 These approaches include developing healing intention, experiencing personal wholeness, cultivating healing relationships, practicing healthy lifestyles, applying collaborative health care, creating healing organizations, and building healing spaces.22

Florence Nightingale was one of the first to address issues related to healing spaces with her focus on characteristics of the external environment like lighting, noise, and sensory stimulation. With the role of the nurse focused on putting the patient in the best possible condition for nature to act so healing can occur,23 there is no question Nightingale would challenge us to recognize the effects of the ICU environment on the patient and manipulate as many features as possible to transform the ICU into an OHE. As nurses, we have the power to offer OHEs19 for our patients every day by: (1) creating healing spaces as we reduce environmental stressors, provide positive diversions, and connect patients to nature; (2) promoting relationships by ensuring patients have access to their support network; and (3) fostering collaboration by offering patients options and choices that normalize environmental sights and sounds within their treatment and care.

FINANCIAL DISCLOSURES
None reported.

REFERENCES


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