



Correspondence

Sleep in the ICU – A complex challenge requiring multifactorial solutions

There is increased awareness of sleep deprivation in the ICU and the potential negative sequelae associated with this. Showler et al. recently showed that nonventilated ICU patients were awake for a median of 4 h overnight,¹ aligning with studies demonstrating highly fragmented sleep with limited deep sleep^{2–4} and a median duration of unbroken sleep of less than 10 min,⁵ making poor sleep quality one of the most commonly reported stresses by ICU patients.^{6–9}

Sleep is essential for good health and healing with deep sleep considered vital for brain repair and recovery.^{10,11} The poor sleep experienced by ICU patients is therefore of great concern, suggested to be associated with adverse outcomes such as increased mortality, delirium, mental changes, decreased cognitive/physical function, and prolonged mechanical ventilation.^{3,7,12,13} However, evidence describing the contribution of disrupted sleep to clinically important outcomes for critically ill patients remain scarce.^{14,15}

Sleep disruption in the ICU is a complex and multifactorial issue. Contributing factors include staff interventions, illness severity, medications, pain, anxiety, mechanical ventilation, delirium, and environmental factors such as noise and suboptimal lighting.^{4,13,16,17} Some of these are modifiable and, if addressed, may improve patients' sleep. However, objective sleep measurements are complex and difficult in ICU, with no simple bedside tools available to accurately measure sleep. It is therefore hard to set sleep targets and determine whether they are being met. The gold standard polysomnography is impractical due to the need for specialised equipment and staff. Actigraphy and other devices inferring sleep from movement or activity levels are impacted by common ICU factors and interventions and commonly overestimate sleep.^{14,18} Therefore, questionnaires or staff observations are frequently used. Difficulties associated with measuring sleep accurately might contribute to insufficient clinical interest in this area, with few ICUs having a local sleep promotion guideline or policy.¹

Evidence describing successful interventions that improve patients' sleep in the ICU is limited. To optimise sleep hygiene, various bedspace design and technological improvements should therefore be considered in parallel with an increased clinical focus on sleep optimisation. Promising available solutions addressing environmental factors negatively affecting sleep include sound masking,^{14,19} circadian lighting solutions,^{20,21} family visitation (in person and virtually),^{22,23} inclusion of a balcony and biophilia,^{24,25} environmental redesign to address noise pollution, alarm burden, and suboptimal lighting,^{26–28} and masking the alarms and noise unable to be eliminated by personalised, calming sounds such as relaxing music and nature sounds.⁷ Emerging solutions include 'silent ICU' and alarm management solutions, sound-absorbing materials that maintain infection control measures, and other solutions allowing personalisation of the bedspace environment. However, research investigating the impact of these solutions is still in its

infancy. To date, published literature has commonly described the potential solutions or inferred benefits from other patient populations, rather than demonstrate improved outcomes for ICU patients.

Understanding the impact of poor sleep in ICU on recovery and the effectiveness of emerging solutions on patient outcomes are important research priorities. Future studies need to evaluate the effect of design and technological solutions and their impact on health economy and patient-centred outcomes, including sleep. Similarly, future studies should focus on developing and evaluating simple, user-friendly bedside tools that can measure sleep continuously, effectively, and with staff feedback loops, such as single-channel electroencephalogram devices or using cardiorespiratory signals.²⁹ Combined, this may assist in the identification of effective strategies that improve sleep in ICU, which will hopefully translate to improved patient outcomes.

CRediT authorship contribution statement

Oystein Tronstad: Conceptualisation; Writing - original draft; Writing - review & editing. **John F. Fraser:** Conceptualisation; Supervision; Writing - review & editing.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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