



EDITORIALS

Excessive noise in intensive care units

Bad for staff and very bad for patients

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Noise levels in the intensive care unit are known to be high. World Health Organization (WHO) guidelines suggest hospital noise levels should average 35 dBA during the day and 30 dBA at night.¹ Research conducted by our group in five local units recorded levels just under 60 dBA during the day (equivalent to a busy restaurant) with peaks above 100 dBA 22–28 times every hour. Although it was quieter at night, we still identified peak sounds above 85 dBA up to 16 times an hour.² These data are consistent with those of other studies. No study in a 2012 review recorded sound levels within WHO recommendations, although some interventions achieved significant reductions in sound levels.³ Staff activities and alarms are primary sources of disturbance in intensive care units,⁴ but noises from other patients and infrastructure also contribute.

Staff and patients may be in a chronic state of alertness when alarms are constantly sounding. Alarms share characteristics with the human scream and tend to activate areas of the brain that recognise danger. Raised sound levels have been associated with increased stress for staff,^{5–7} and non-clinical studies show that noise adversely affects physiology, motivation,^{8–9} and general health.¹⁰

The brain has a limited resource for processing information, and sensory overload caused by high noise levels and complex patient needs can lead to fixation bias and loss of situational awareness among staff.^{4–11} The cognitive cost associated with the subconscious processing of distractor noises limits the brain's ability to process auditory and visual information.¹² Desensitisation to background noise may reduce staff alertness. Up to 75% of alarms are false alerts, require no immediate action, or are simply ignored.¹³ It is also difficult to distinguish serious problems from minor ones as all machine alerts sound urgent to the untrained ear. Alarm fatigue has been cited as a leading hazard faced by hospitals in the United States,¹⁴ and the Royal College of Anaesthetists' safe anaesthesia liaison group has prioritised this as an area for improvement in the United Kingdom.

Volunteers exposed to a simulated intensive care environment show disturbed sleep and biochemical markers of stress,¹⁵ and patients attribute difficulties with sleep to disturbances around them.

Typical sleep in intensive care units has been reasonably well characterised even though it is difficult to measure accurately. Patient sleep is fragmented and brief. A review of intensive care and postoperative sleep studies found that patient sleep in intensive care is highly variable,¹⁶ and in two observational studies in Australia and the UK patients had three to five hours sleep in any 24 hours, with a median duration of unbroken sleep of just three minutes or less.^{17–18} Most patients in general intensive care units are not heavily sedated for long periods and would be expected to have near normal sleep patterns if they were not in hospital.

Disrupted sleep could be a trigger for intensive care unit delirium. Links between psychological disturbances and poor sleep are recognised, and paranoia symptoms can be reduced in psychiatric patients simply by improving sleep.¹⁹ Descriptions of patient experiences in intensive care make harrowing reading.^{20–21} Between 30% and 75% of patients experience at least one delirious episode while in intensive care. These patients tend to have longer hospital stays and long term health problems after they have been discharged home.²² There are clear benefits to preventing delirium when possible and to minimising the duration and adverse effects when it occurs.

A recent meta-analysis confirms the link between patient exposure to high noise levels and delirium.²³ Ear plugs may be a simple solution. However, ear protection is not suitable for all patients and does not tackle problems of staff communication, staff wellbeing, or potential for clinical error. Side rooms offer some protection from disturbances caused by other patients, but patients remain at risk of noise from their own physiological monitoring.

Lowering environmental noise levels, even modestly, may help patients sleep, improve staff concentration, and result in fewer episodes of delirium. Building design and materials can reduce noise, and various quiet periods have been trialled with mixed results.^{24–25} Staff education can be effective, as can individualising alarm thresholds and volumes, and use of visual alerting. Anecdotally, changing culture has been one of the hardest barriers to overcome. More and better trials of interventions designed in partnership with patients and families are urgently required, along with newer approaches such as

“experience based codesign” (www.kingsfund.org.uk/projects/ebcd).

Smarter alarm algorithms are also promising, offering opportunities to deliver intuitive alerting without increasing overall noise levels. Frequency and tone affect the visceral response to noise perhaps more than overall decibel levels.

It seems unlikely that WHO limits can ever be achieved in full, and they should perhaps be revised. Changing monitoring standards to take account of psychological effects of noise would be a welcome shift in attitudes to the problem. But moving away from a single 24 hour average sound target to include measures of frequency may be a better way of describing acceptable sound levels for hospital environments. Defining an achievable and evidence based target specific to intensive care units would also be helpful. Technological advances should also help us design environments that are more conducive to patient recovery and efficient working practices.

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VIEWS AND REVIEWS

The intensive care unit was so noisy I couldn't sleep

Now researching the issue, Lisa Hinton experienced the pandemonium at first hand

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Patients may imagine that intensive care units (ICUs), where lifesaving high tech care is delivered to very sick people, are as quiet as a chapel. But they're not. The World Health Organization says that noise levels in the average ICU should be no higher than in a library, at 35 dB. In reality, ICUs are as loud as a main road or a busy restaurant: one UK study recorded noise peaks above 85 dB—equivalent to a road drill—as many as 16 times an hour in an ICU.¹

Several years ago I spent many weeks in one of those ICU beds. I wasn't your typical ICU patient, who tends to be older or to be admitted after a planned procedure or an accident. In my early 30s I developed pneumonia, then sepsis, and was critically ill for several weeks. Like many such patients, when I was woken up I didn't understand where I was. A combination of severe illness, sedation, and a tracheostomy left me unable to talk or move. I felt completely trapped and vulnerable. The loud noises and activity around me were confusing and threatening.

Constant and unpredictable

I could hear chatter and activity from the staff, crashing bin lids, and disturbing noises from other patients. But the constant and unpredictable alarms were the worst. The beeping of life support systems communicates to staff that all is well or that something is wrong and needs their urgent attention. As a patient, you can't distinguish between these. So, when the alarms went off, it was terrifying: it might have been me or my machine failing. As I could neither move nor call out, I feared that I'd die before anyone noticed. The machines run 24/7. The noise and consequent anxiety were constant.

At first, being awake after spending weeks "asleep" was good news—it meant that I was on the mend. But being awake soon became a nightmare. I couldn't get back to sleep because my surroundings were too noisy and I was too scared. Sleeping pills, which I eventually managed to communicate that I needed, did no good. I knew that this elusive sleep was important for my recovery and getting home. Staring at the clock on the wall as it spun slowly through its 12 hour shifts was torturous. It wasn't until I was discharged to the general ward that I got some decent sleep. This must have slowed my recovery, and it made my experience of an ICU all the more traumatic.

This is common. A recent quality improvement study led by colleagues at the University of Oxford and King's College, London tackled the disruption caused by noise and light. This, in turn, drew on a secondary analysis of interviews with patients and carers about intensive care, many of whom talked about noise—particularly from equipment, other patients, and their visitors. The 24 hour activity and bustle in ICUs was often challenging for patients and caused distress.²⁻⁴

Disturbed sleep patterns

Many patients who are treated for more than a couple of days in an ICU have disturbed sleep patterns, hallucinations, and periods of delirium. These are due to environmental factors (loss of day and night, continuous background noise), as well as their acute illness and associated treatments.⁵⁻⁹ Patients who become confused stay longer in hospital and often have more health problems after they go home.¹⁰ So, tackling noise levels is a clinical and economic priority.

A decade on from my ICU experience, I'm collaborating with clinical and research colleagues at Oxford to reduce noise levels, to see how we can improve sleep and reduce confusion. If we can reduce noise levels in ICUs we could improve patients' experiences and outcomes. Our mixed method study seeks to identify the common sources of noise and find ways to reduce them. Although we're never likely to achieve the recommended WHO limits, there's room for considerable improvement.¹¹

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