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### Extended Duration Workshifts: S. Mountain, The Impact on House Staff and Patient Safety

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'On call' or extended duration shifts, i.e., shifts greater than 24 hours in length, are commonly worked by house staff in critical care settings, resulting in both acute and chronic sleep deprivation. It has been well demonstrated that this degree of fatigue impairs cognitive function on standardised tasks. Furthermore, recent studies, including those specifically focussed on critical care units, have shown that house staff fatigue negatively impacts both patient and occupational safety outcomes.

#### **General Effects of Sleep Deprivation**

Loss of sleep can either be "acute-continuous", such as is experienced after a single extended shift, or "chronic-partial", as occurs with a busy schedule that repeatedly causes an individual to sleep less than they would if given sufficient opportunity. Interestingly, either type of sleep loss can have significant impacts on performance.

Studies comparing the effect of 24 hours of wakefulness to that of elevated blood alcohol levels found that standardised tasks in sleep-deprived subjects were impaired as if they had blood alcohol levels of 0.05 to 0.10% (above the legal driving limit in all US states).

Recurrent sleep loss on a daily basis can have a similar effect. This type of sleep reduction tends to have a cumulative impact, with dose-dependant reduction in cognitive performance. For example, chronic restriction of sleep to six hours or less per night for two weeks produces cognitive performance deficits similar to one night of total sleep deprivation. Restriction to four hours per night for two weeks produces performance deficits equivalent to two nights of total sleep deprivation. For ICU staff other than interns and residents, this type of sleep deprivation is probably the most common.

#### **Impact of Sleep Deprivation on Occupational Safety**

The threats to patients and occupational safety of sleep-deprived ICU house staff are often overlooked. However, it is important for ICU managers to be aware of the risks, both out of concern for their fellow workers, and in consideration of the staffing and legal liability implications.

The increased risk of a motor vehicle collision (MVC), or near miss incident, has been demonstrated in large cohort studies of interns and residents working extended shifts. The threat has been quantified as up to a four-fold increase of an MVC, and a six-fold increase of a near-miss incident. With multiple extended shifts in a month, the risk of falling asleep while driving is increased by almost four times.

Interns working extended shifts have also been found to have a significantly increased risk of percutaneous injuries (needle sticks or lacerations). After working overnight in the ICU, residents have been shown to have a risk of such injuries that is nearly double that of their rested colleagues.

Other less easily quantified health risks exist as a result of recurrent work related fatigue. Many authors have demonstrated an increased rate of mental health concerns in fatigued interns and residents, including increased rates of stress, depression, and burnout. In the ICU, serum levels of inflammatory markers have been shown to be elevated in house staff working extended shifts.

### **Impact of Sleep Deprivation on Patient Safety**

Until recently, studies examining patient outcomes as a function of house staff fatigue have been rare, and sometimes contradictory. It has been suggested that the variability in results may be a function of sleep deprivation impacting different tasks to different degrees (Barger et al. 2006). In the past several years, in an effort to determine the ICU-specific risks, several studies have examined the effect of alternative house staff schedules on fatigue and patient outcomes.

In a crossover trial of house staff working in critical care units at the Brigham and Women's Hospital in Boston, Massachusetts, interns worked both a traditional schedule and a schedule that eliminated extended work hours and replaced them with shifts no longer than sixteen hours. During the traditional schedule, in which they were on-call overnight every third night, interns made 36% more serious medical errors, and diagnostic errors increased almost six fold (Landrigan et al. 2004). Alternative shift schedules have been criticised for the possibility that the requirement for increased handover may lead to losses of relevant information, and worsened patient outcomes. However, investigators examining this premise have not shown any difference in patient mortality or ICU length of stay associated with shorter shift schedules (Afessa et al. 2005).

### **Optimising Shift Length**

Optimal shift length and frequency has not been systematically determined for any members of the ICU team. The cumulative negative effects of fatigue suggest that it is important to be aware of potential performance impacts for all ICU workers, not just house staff. Certainly it seems advisable to limit or eliminate the number of times in a month that extended shifts (>24 hours in length) are worked, whether they are a result of traditional scheduling practices or excessive overtime.

With respect to interns and residents, this data regarding various scheduling strategies allows us to make some inferences as to optimal shift length. We have already reviewed the evidence suggesting that shift lengths of no more than sixteen hours significantly reduce the incidence of serious medical errors. In Europe, thanks to the introduction of the European Working Time Directive, it has been possible to examine the other end of the spectrum.

Investigators in Germany have shown that eight-hour physician shifts were inferior to twelve-hour shifts with respect to multiple ICU outcomes, including length of stay, readmission, and frequency of complications (Bollschweiler et al. 2001). These results suggest that shorter shifts may carry their own risks, possibly validating concerns about adverse events related to handovers and discontinuity of care. Nevertheless, optimal shift lengths for ICU house staff are likely between twelve and sixteen hours. For other ICU workers, such as nurses, who may require longer periods of uninterrupted focus, shorter shift lengths may be preferred, although presumably increased handover between nurses also contributes to patient risk.

### **Conclusion**

Sleep deprivation caused by extended duration shifts contributes to significant risks for both staff and patients. Reduction of these risks is possible by optimising shift lengths, and being aware of the effect of cumulative fatigue due to chronic shortened sleep hours. Currently, especially in North America, few ICUs have adopted alternative schedules despite mounting evidence suggesting a significant reduction in medical errors, and improvement in employee health and safety. Consideration for the well-being of our fellow workers and the safety of our patients should provide sufficient motivation to consider breaking with tradition and implementing more appropriate scheduling practices.

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