

Sliding Down the Bell Curve: Effects of 24-hour Work Shifts on Physicians' Cognition and Performance

Comment on Saxena AD, George CFP. Sleep and motor performance in on-call internal medicine residents. *SLEEP* 2005; 28(11): 1386-1391.

Philibert I. Sleep loss and performance in residents and nonphysicians: a meta-analytic examination. *SLEEP* 2005; 28(11): 1392-1402.

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IN 1999, THE INSTITUTE OF MEDICINE ESTIMATED THAT MEDICAL ERRORS RESULT IN MORE THAN A MILLION INJURIES AND UP TO 98,000 DEATHS EACH YEAR IN THE United States,¹ making medical error the sixth leading cause of death nationwide.² Since that time, an expanding body of research has shown that a major contributor to this astonishingly high incidence of serious error is the inadequate sleep of health care providers themselves.³⁻⁸ The Harvard Work Hours, Health, and Safety Study found that interns working traditional in-hospital extended "on-call" shifts of 24-30 hours every other shift (a "q3" schedule) suffered twice as many polysomnographically-recorded attentional failures while working at night, and made 36% more serious medical errors in the care of their patients – including 5 times as many serious diagnostic errors – as interns limited to 16 hours of scheduled consecutive work.^{9,10} Arnedt et al recently found that pediatric residents working "heavy call" (>24 hour shifts every fourth to fifth night) performed on standardized neurobehavioral and simulated driving tasks similarly to residents with a blood alcohol level of 0.04 to 0.05%.¹¹ Rogers et al found that nurses working longer than 12 consecutive hours or more than 40 hours per week had more than 3 times the odds of making a medical error.¹²

Two papers published in this issue of *SLEEP* further define the role of sleep loss in patient safety and suggest how far we must still go to address this problem adequately. In "Sleep and Motor performance in On-Call Internal Medicine Residents," Saxena and George find that internal medicine residents working on-call shifts (28 consecutive hours) every 3 to 6 shifts (a "q4" to "q7" schedule) suffer significantly more reaction time lapses than rested physician controls, regardless of whether tests were administered post-call or on other days.¹³ The persistence of impaired reaction times throughout the month, even following several nights' sleep at home, demonstrates the powerful detrimental effects of extended shifts and chronic partial sleep deprivation on house officers' performance. Even call as infrequent as "q7" did

not allow full sleep recovery between on-call episodes, and led to lasting performance deficits. Very significantly, residents failed to perceive this impairment. Although aware of their sleepiness when post-call, they rated their alertness highly when not post-call, despite Psychomotor Vigilance Test data to the contrary.

In the second article, "Sleep Loss and Performance in Residents and Non-Physicians: A Meta-Analytic Examination," Philibert has conducted a rigorous, comprehensive meta-analysis of 60 studies investigating the effects of sleep loss on the performance of 959 physicians and 1,028 non-physicians.¹⁴ Prior meta-analyses have sought to systematically gather the evidence regarding sleep deprivation and human performance, but none have focused so extensively on physicians as a sub-group. Two important contributions of this study is its isolation of the effects of sleep deprivation on physicians' clinical and non-clinical tasks, and its differentiation of the effects of varying degrees of total acute sleep deprivation (24 to <30 hours, 30 to <54 hours, and >54 hours) on physicians' performance. Philibert finds that even sleep deprivation of 24 to <30 hours, an amount within current Accreditation Council for Graduate Medical Education (ACGME) work hour limits for resident physicians,¹⁵ leads to extreme degradation of residents' cognitive and clinical performance.

Acute sleep deprivation degrades physicians' performance to a frightening degree. In Philibert's analyses, the average cognitive performance of physicians experiencing consecutive sleep loss of 24-30 hours fell 0.986 d scores to the fifteenth percentile of rested performance levels. 24-30 hours of sleep loss degraded clinical performance even further, to that of the seventh percentile of rested physicians (-1.536 d scores). To put such drops in intellectual performance into perspective, it may be useful to consider what an analogous drop on a familiar population-based performance metric – the Intelligence Quotient – would mean. A reduction in human cognitive performance to the fifteenth percentile would be equivalent to decreasing the average human IQ from 100 to 85;¹⁶ a drop to the seventh percentile would be analogous to a drop to nearly 70, a level bordering on mild mental retardation.

Although the magnitude of cognitive loss this analogy suggests is quite disturbing, the finding that sleep loss deeply impairs thinking and performance is not new. Extensive, decades-old data from across occupations have established that sleep deprivation and circadian misalignment greatly increase the risk of industrial errors and accidents.¹⁷⁻¹⁹ Recognizing these risks, safety-sensitive industries such as aviation and trucking implemented limits on

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consecutive work hours years ago.²⁰⁻²²

Physicians need to come to terms with their biological limits, and take steps to prevent these limits from harming their patients. Current ACGME policy continues to endorse resident work weeks of 80 hours and shifts of 30 consecutive hours, including time for transfer of patient care. The justifications for perpetuation of such long shifts has been to limit the possibility of hand-off errors as well as to foster resident training through intensive continuous in-hospital experience. Evidence demonstrating that long shifts are necessary either to assure good training or avoid hand-off errors, however, is notably absent. By contrast, as demonstrated so eloquently by Philibert in this issue of *Sleep*, a wealth of evidence substantiates the very real risks to patients of physician sleep deprivation. In the only randomized trial to test a system with traditional 30-hour shifts and few hand-offs against a system with more frequent hand-offs of care but no extended shifts, the no-extended-shifts system was far safer, despite the avoidable miscommunications that occurred.^{10,23}

Few passengers would be comfortable flying with an exhausted pilot who had been working in the cockpit for 24 consecutive hours, never mind one who had done so every third or fourth night for the past several years. Yet this is the norm in medicine, largely because we have fostered a professional ideal that doctoring requires unceasing self-sacrifice and sleeplessness in the service of the patient. The sad irony, however, is that in refusing to care for themselves, to acknowledge their own essential biological needs, physicians do not care well for their patients. Exhausted physicians make critical errors, injuring the very patients they seek to heal.

The public, incidentally, recognizes the risks of physicians' sleep deprivation. A 2002 National Sleep Foundation poll found that half of the public believe physicians should work 10 hours or fewer; 86% would be "extremely anxious" to learn that their surgeon had been awake for 24 hours, and 70% claimed they would likely ask for a different doctor.²⁴ The fact that patients rarely make such requests underscores the lack of transparency in the medical consent process, and patients' consequent unawareness of the risks to which they are exposed in hospitals. It demonstrates how much more we must do to involve patients in the process of improving patient safety.

Philibert cautiously suggests that "the weekly hours and continuous wakefulness permitted under the current national minimum standards for residents may not completely guard against the negative effect of sleep loss on cognitive and clinical performance." Her data and the emerging literature, however, go much further than this. Residents working 30 hours in a row under the current guidelines of the ACGME perform as poorly as if intoxicated. The intelligent, motivated, highly-educated graduates that our medical schools produce are reduced by an overnight, 24-hour shift to a fraction of their intellectual selves. Our patients are endangered by their work hours. And as Barger et al demonstrated recently, our trainees' themselves and the general public are endangered; residents driving home after shifts of >24 hours have twice the odds of crashing their cars.²⁵

It is well past time that we eliminate residents' extended shifts. If we wish to assure that hand-off errors do not endanger patients, we should seek to improve our hand-off systems. If we wish to assure that our residents are well-trained, we should seek to increase the efficiency and quality of their training experience. Neither of these imperatives require the prolonged, traditional shifts that are

so patently endangering our patients, house staff, the public, and ultimately, ourselves. To protect our trainees and patients, the dangerous tradition of 24-hour shifts must at last be put to rest.

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