Fatigue

Physicians' work hours: desperately seeking evidence

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Commentary on the paper by Gander *et al* (see page 733)

Evidence-based medicine is the cornerstone for excellence in healthcare delivery. However, as a group, physicians have been reluctant to advance the necessary science and to examine in depth related science to formulate evidence-based safe work schedules.

A case in point is the history of work hour regulation for physicians in training in the USA. The first statewide attempt to regulate work hours occurred over 20 years ago in response to the death of a young woman in a New York City hospital. The woman's father was a *New York Times* reporter and former federal prosecutor, who pressed for criminal prosecution. A grand jury heard the case and concluded that the prolonged work hours of the house staff (junior doctors) caring for the woman contributed, in part, to a medication mistake that resulted in the young woman's death. An ad hoc advisory committee of prominent physicians, without expertise in sleep and circadian disorders or neurobiology (the Bell Commission), reviewed the grand jury's report and agreed that excessive work hours might have resulted in fatigue-related errors. The committee developed a work hour policy based simply on the mathematical midpoint between the 40-hour workweek schedule for the majority of the American workforce and the 120-hour workweek that many house staff in New York City were working at that time. Without a well-substantiated scientific basis, this costly regulation was not enforced. Eventually, medical students in the American Medical Student Association began to fight for better work hours prior to their impending residency programmes. In a brilliant move, they petitioned the Occupational Safety and Health Administration (OSHA), asking that the OSHA investigate the safety of work hours for residents. The Accreditation Council for Graduate Medical Education (ACGME) was informed of this petition and conveyed to the OSHA they would address this issue carefully. In part wanting to do the right thing and in part concerned that they would lose control

over the residency work hours, the ACGME settled with the medical students agreeing to strictly enforce work hours. In a less brilliant move, the medical students asked for the Bell Commission work hours. The ACGME agreed, promising tightly controlled regulation of the new work hours, and the OSHA was avoided. Consequently, the present work hours so vigorously regulated in the USA for residents are very close to the original Bell Commission work hours: 80 h/week, with on-call duty no more frequent than every third night; on-call shifts no longer than 24 h, but up to 30 h for transfer of care to the next resident, and on average one full day off every seven days.

Importantly, it is never too late to advance the science of safe work hours. Indeed, there are many unresolved issues regarding physicians' work hours. For example, does the new 80-hour workweek reduce medical error? What is the optimal number of workweek hours that residents should work to balance patient safety and learning? What factors, aside from workweek hours, contribute to impaired physician performance?

Presently, there is no evidence that the 80-hour workweek increases patient safety. In the early 1990s, there were three retrospective studies in New York examining the effect of the 80-hour workweek on either medical error or patient mortality. All three studies are limited by the lack of documentation of actual work hours and by retrospective study design.¹⁻³ Nonetheless, the studies found no improvement in patient outcomes, and one study showed increased mortality and greater delays in diagnostic testing after the imposition of an 80-hour workweek.³ Findings are mixed on whether the 80-hour workweek hinders education.⁴⁻⁷ The most consistent effect of the 80-hour workweek is improvement in quality of life for the residents.⁸ Thus, two decades after the beginning of work hour regulations for house staff in the USA, we do not know how many total hours a physician or physicians in training can work effectively, efficiently and safely, or

whether total hours per week is an important factor in fatigue.

Returning to carefully controlled studies, there are important factors beyond total hours of wakefulness or work that contribute to fatigue and error. Alertness requires both the fulfilment of the homeostatic drive for sleep and circadian arousal timing.⁹ For example, healthcare providers who work only 40 h/week are not immune to fatigue and cognitive impairment if they experience extended (>10 h) time on the job or must work early morning hours without adjusting circadian timing. The Australian Medical Association has taken a lead in organising extensive discussions with experts in alertness and shift work, hospital administrators, nurses and physicians and integrating data from many sources to develop a list of the most likely contributors to fatigue-related error.¹⁰ In addition to total hours, the factors include night duty, shift schedule change frequency, short breaks between work periods, commuting time, age, medical experience, and supervision. Of note, based on this checklist, many American residency programmes adhering completely to the ACGME work hour regulations would still fall into the "high risk" category for fatigue-related error.

In this month's issue Gander *et al* take advantage of this well thought out risk assessment tool to identify relative risks for fatigue in physicians and medical error and to validate the Australian risk assessment tool (see page 733).¹¹ They performed a national survey of physicians in training in New Zealand that included all items on the Australian Medical Association National Code of Practice checklist to determine individual risk. Total hours worked per week, >70, 50-70 or <50, was not an independent risk factor for fatigue-related medical error. In contrast, the frequency of night shift duty and being a physician in training were independent risk factors for fatigue-related medical error. Night duty, schedule change and commuting distance were all independent risk factors for sleepiness while driving. Interestingly, the presence of supervision at work reduced the risk for both fatigue related medical error and sleepiness while driving. These findings support the concept that reducing work hours alone will not deliver alert doctors to the bedside. Further, these findings support the concept that night shift schedules remain a major risk for medical error. To begin to address this important healthcare concern, we must identify effective means of adjusting the circadian rhythm in all healthcare workers working night shifts and we must be able to monitor

entrainment in night shift workers. At the same time, there will be emergencies when physicians must work across circadian nadirs and, for these times, we must identify optimal short sleep schedules and truly effective fatigue counter measures.

One important factor left out of the Australian Medical Association's risk assessment checklist is how rested physicians are at the start of duty. Sleep loss has cumulative effects on performance, and the intern or resident who is out late at night is far more likely to have lapses in judgment and performance than the well-rested intern or resident. It is essential that the interns/residents do their part to minimise fatigue-related error. This particular point cannot be regulated, and therefore requires a cultural change. As such, physician role models must reiterate this particular point frequently.

In conclusion, while we await improved science upon which to base work hour schedules for healthcare

providers, the Australian Medical Association's National Code of Practice for work hours, combined with the cultural change of delivering rested physicians to the bedside, is an excellent foundation on which to build evidence-based practice of safer work hours.

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REFERENCES

- 1 Daigler GE, Welliver RC, Stapleton FB. New York regulation of residents' working conditions. 1 year's experience. *Am J Dis Child* 1990;**144**:799–802.
- 2 Howard DL, Silber JH, Jobes DR. Do regulations limiting residents' work hours affect patient mortality? *J Gen Intern Med* 2004;**19**:1–7.
- 3 Laine C, Goldman L, Soukup JR, et al. The impact of a regulation restricting medical house staff working

hours on the quality of patient care. *JAMA* 1993;**269**:374–8.

- 4 Jaggi R, Shapiro J, Weissman JS, et al. The educational impact of ACGME limits on resident and fellow duty hours: a pre-post survey study. *Acad Med* 2006;**81**:1059–68.
- 5 Brunworth JD, Sindwani R. Impact of duty hour restrictions on otolaryngology training: divergent resident and faculty perspectives. *Laryngoscope* 2006;**116**:1127–30.
- 6 Hutter MM, Kellogg KC, Ferguson CM, et al. The impact of the 80-hour resident workweek on surgical residents and attending surgeons. *Ann Surg* 2006;**243**:864–71; discussion 871–5.
- 7 Karamanoukian RL, Ku JK, DeLaRosa J, et al. The effects of restricted work hours on clinical training. *Am Surg* 2006;**72**:19–21.
- 8 Lockley SW, Cronin JW, Evans EE, et al. Effect of reducing interns' weekly work hours on sleep and attentional failures. *N Engl J Med* 2004;**351**:1829–37.
- 9 Van Dongen HP, Dinges DF. Investigating the interaction between the homeostatic and circadian processes of sleep-wake regulation for the prediction of waking neurobehavioural performance. *J Sleep Res* 2003;**12**:181–7.
- 10 Australian Medical Association. *National Code of Practice: Hours of Work, Shiftwork and Rostering for Hospital Doctors*, AMA, 2005.
- 11 Gander P, Purnell H, Garden A, et al. Work patterns and fatigue-related risk among junior doctors. *Occup Environ Med*, 2007;**64**:733–8.

Genetics

Genetics and occupational safety and health

Karl T Kelsey

Commentary on the editorial by Schulte (see page 717)

In occupational health much has been made of the potential impact of the "genetic revolution" on worker health.¹ Schulte² and OEM are right to ask the direct question—what hath this wrought? In the accompanying editorial Schulte acknowledges that although genetics has not yet had a major impact upon occupational health and safety, with continued research critical questions raised by this type of information will need to be addressed and answered.² Has what we posited 20 years ago to be a relatively straightforward march toward understanding genetics and integrating these data into exposure-related disease susceptibility become so very complex? Just how important is this issue and how far away are we from genetics having any palpable effect on worker health?

The general approach to the hazardous environment can be characterised by (1) problem recognition, (2) evaluation of the environment, and (3) application of controls (including prevention and hazard elimination). This simple guiding paradigm has stood the test of time. We apply

it today, intuitively and explicitly including the rapid changes in science and technology. Does the genetic revolution affect our paradigm? Indeed, it is probable that knowledge of genetic susceptibility to a toxicant or infectious agent could affect our recognition of potential harm as well as our parallel evaluation of the hazardous environment. In fact, it also might suggest novel control strategies or approaches to hazard elimination. Hence, keeping a watchful eye on the progress of this "revolution" is indicated.

Where are we to look for the signposts? As Schulte suggests, genetic variation in individual response to exposure to beryllium stands as a prominent example. Here the science is sound and there is active discussion of the appropriateness of worker genetic testing and screening.³ The practice of occupational medicine in this one area has incorporated the genetic data, although as yet there is no consensus on its potential utility. Although the science addressing genetic susceptibility to workplace toxicants is not similarly established for any

other case, it is conceivable that this may occur. In the case of infectious agents, we have the example of the *CCR5* polymorphism and its association with resistance to HIV.⁴ Here the science is sound, but this has had less prominent effects upon worker health. It is similarly likely that there will be genetic variation described that will have a significant impact on individual susceptibility to other important infectious agents, such as tuberculosis.⁵ This will resonate in the healthcare workplace, as well as in other workplaces where this disease is endemic.

Interestingly, what these cases have in common is that they are single agent exposures with a pathologic process involving pathways that are either known or under very close scrutiny. Thus, one is tempted to assert that it is far too early to look for scientifically useful biomarkers of susceptibility to complex mixtures and complex environments. As this really represents the majority of workplaces, it is completely possible that the genetic revolution will affect worker health only very moderately in the foreseeable future. That is not to say that genetics may not have profound influence; rather, the simple has become complex, and the utility of this technology must await a scientific consensus that is likely to remain elusive.

So, what of the contributions in the meantime? Where will this research have an impact? Assessing this landscape, it is likely that the study of genetics and genomics applied to exposure-related disease will point us in new directions and thereby reap enormous rewards in defining