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Some Practical Considerations and Policy Implications of Studies of Sleep Patterns

Merrill M. Mitler, PhD and **James C. Miller, PhD, CPE**

*is director of research of the Division of Sleep Disorders of the Scripps Clinic and Research Foundation in LaJolla, California, where **Dr Miller**, a certified professional ergonomist, is a research scientist with the Laboratory for Sleep, Fatigue and Safety.*

The companion article by Mitler and Miller (pps 000) suggests a number of issues for policy makers. Federal legislators have already been alerted to some of these issues.

Scientists with the Office of Technology Assessment of the US Congress have reviewed the impact that diurnal variation in sleep and performance have on safety and productivity in a variety of industries worldwide¹ and have provided lawmakers with a number of legislative options aimed at limiting loss of life and property. Thus, problems relating to human sleep tendency are being addressed at all levels of our society and government.

Among the most challenging public-policy issues are (a) the rate and temporal distribution of human error catastrophes that should be considered unavoidable and normal, (b) the degree to which a person's sleep tendency must rise before it is considered a risk to the person or to the public, and (c) the extent to which human error caused by abnormal or normal levels of sleepiness can be reduced.

Multiple-nap studies of the kind shown in Figure 4 in the preceding article (page 000) have focused on normal populations. Such studies will undoubtedly continue and should refine our understanding of the normal temporal interrelationships between sleep and performance. However, what about the abnormal? Recently, the timing of ups and downs in human sleep tendency have been associated with, if not causally linked to, the timing of industrial and transportation catastrophes and mishaps caused by human error.²

The various methods of testing for sleepiness that we have considered show unequivocally that there are critical periods before dawn and in the middle of the afternoon when sleepiness and inattention may lead to errors that cause industrial incidents and accidents. This phenomenon is biologically based and clearly affects a variety of decision makers, such as policy makers, factory managers, and healthcare administrators. How can we use the information about sleepiness that we now have to improve public safety?

Recognizing the Problem

First, we should recognize that a huge increase in the amount of energy a typical worker controls has occurred during the last century. For example, a truck driver in the 1900s controls several orders of magnitude more potential and kinetic energy than a stagecoach driver did in the 1800s. When the truck driver falls asleep on the job today, much more is at risk than when the stagecoach driver fell asleep a century ago. Yet the biology and sleep needs of both drivers are identical.

Second, we should recognize that it is impossible in the modern era to avoid assigning a significant portion of the work force to night work. We should also recognize that night work always compromises a person's ability to acquire adequate sleep.

Third, we should recognize that we have not yet designed many jobs and systems to use human operators effectively. Any such design should exploit natural human strengths, such as pattern recognition and decision making. It should also protect the system from natural human weaknesses, such as vulnerability to attentional lapses in boring surroundings, especially during critical periods of the 24-hour day and under conditions of sleep deprivation.

Fourth, we should recognize that the methods for identifying unacceptable sleepiness that are currently available to laboratory researchers do not lend themselves to widespread use in the workplace—even if some level of sleepiness could be agreed upon as unacceptable for job performance.

Taking the First Steps

Once we accept these ideas, what can we do with our current information and technology? To make a beginning in this very large societal task, we now know when in the 24-hour day industrial errors leading to incidents and accidents are most likely to occur. Therefore, it may be possible to focus job redesign and staffing redesign on those workers whose sustained alertness is required for public safety.

We can then integrate fundamental principles of the sleep research and human factors disciplines with the findings reviewed here. In the accompanying article, Rosekind et al offer suggestions that parallel and complement the following list.

- Examine, through task analyses and other appropriate methods, those safety-sensitive jobs that are most vulnerable to loss of attention.
- Rank these jobs on a scale that reflects each job's vulnerability to attentional lapses and the potential for loss of life, health, and property if an attentional lapse occurs. It is important for this effort to proceed within single businesses as well as across the entire economy. Within a single business, it will probably become apparent which jobs are most safety sensitive (eg, within a trucking company, a driver of an 18-wheeler versus a purchasing agent). Across the economy, however, sophisticated risk assessment and scaling techniques will be required. For example, to rank such jobs as long-haul aircraft pilot, emergency room attending physician, driver of a propane tanker truck, nuclear power plant operator, night nurse, and medical resident, we would have to consider many factors, such as (a) the probability of error, (b) the probability that supervisors will find and correct errors, (c) the consequence of errors, and (d) the duration of exposure to safety-sensitive tasks. All of these factors need to be standardized and mathematically represented in the ranking procedure.
- Focus on the most safety-sensitive jobs in this ranking and use interview and screening methods to identify and treat or exclude persons with sleep disorders characterized by uncontrollable sleep.
- Educate workers about the intelligent management of their principal sleep periods and naps.
- Consider, when developing staffing levels and designing rotating shifts, the periods in the 24-hour day when the vulnerability to sleep and error is greatest.
- Use all means available to double-check or triple-check the safety-sensitive work performed during periods of vulnerability.
- Use daily or more frequent fitness-for-duty testing based upon worker performance of relevant tasks or subtasks to eliminate workers who are impaired for any reason, including sleep deprivation, from safety-sensitive jobs.

- Introduce preplanned naps into the duty periods of selected workers by adapting the approach used for longhaul pilots described by Rosekind and colleague.^{3,4}

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