To sleep or not to sleep? Math software to help plan astronaut, shift worker schedules

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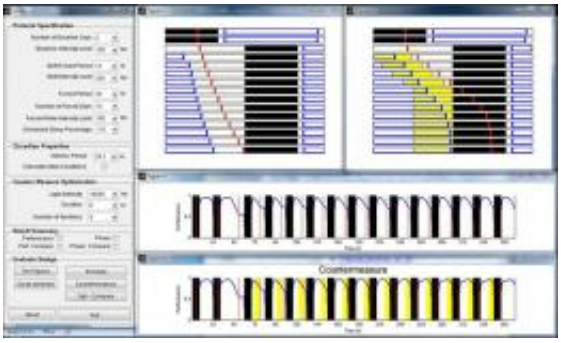

Shifter software screenshot: This program "prescribes" optimal times to use light to shift a person's circadian rhythm to improve performance at critical times in their schedule. Though designed for the space program, the software could be used by people who do shift or night work or who experience jet lag due to travel across time zones. Shifter is part of software being developed by Dr. Elizabeth Klerman and colleagues for the National Space Biomedical Research Institute. (Image courtesy of Elizabeth Klerman, M.D., Ph.D./Brigham and Women's Hospital.)

(April 14, 2010) - Shifting work schedules can wreak havoc on a person's ability to get enough sleep, resulting in poor performance on the job.

Researchers funded by the National Space Biomedical Research Institute (NSBRI) have developed software that uses mathematical models to help astronauts and ground support personnel better adjust to shifting work

and sleep schedules. Outside the space program, the software could help people who do shift or night work or who experience jet lag due to travel across time zones.

"The best methods that we know to help people operate at peak performance are first to ensure that they get adequate sleep, and second that their work schedules are designed to be aligned with the natural body clock," said project leader Dr. Elizabeth Klerman, associate team leader for NSBRI's Human Factors and Performance Team.

According to Klerman, a physician in the Division of Sleep Medicine at Brigham and Women's Hospital in Boston and associate professor at Harvard Medical School, the software has two components. The Circadian Performance Simulation Software (CPSS) uses complex mathematical formulas to predict how an individual will react to specific conditions. CPSS also allows users to interactively design a schedule, such as shifting sleep/wake to a different time, and predicts when they would be expected to perform well or poorly.

The second component, known as Shifter, then "prescribes" the optimal times in the schedule to use light to shift a person's circadian rhythm in order to improve performance at critical times during the schedule.

"If there is a mission event, such as a spacewalk, scheduled at one or two o'clock in the morning, what can we do to help the astronaut to be alert and functioning well at that time?" Klerman said. "Do we suggest a nap or caffeine? Do we shift their sleep/wake schedule? There are a variety of options that we would like to be able to provide."

Scientists know that an individual's performance and alertness are tightly regulated by several factors related to circadian rhythms and the sleep/wake cycle - length of time awake; the timing, intensity and wavelength of light; the amount of sleep the night before; and the body

clock's perception of time. As a result, most people are not able to operate at peak job performance in the late night or early morning hours.

The situation for International Space Station astronauts is complicated by the fact that they often face schedules that are not uniform. A shift in scheduled sleep/wake time, due to an event such as docking, could be as much as eight or nine hours, with the transition taking place over a short period of time. "These dramatic shifts in schedule not only affect the body's ability to know what time it is, but also hinder the body's ability to give the appropriate signals to a person trying to wake up or go to sleep," Klerman said.

With the basic software program complete, the researchers are now working to individualize the model. They want to determine what personal data are needed in order to provide recommendations for individuals. Klerman said the information needed could be as simple as age, or it could require more complicated data.

The software can easily be adapted for use in many occupations. "This program may be helpful for anyone who has to work the night shift, rotating shifts or extended shifts," Klerman said. "It could also help international travelers effectively deal with jet lag."

Workers outside the space industry that could benefit directly are medical personnel, security or police officers, firefighters, those working in transportation such as long-haul truckers, and power plant operators. Klerman suggested that everyone could benefit indirectly from the modeling. "Our lives, including our safety, are impacted by those people who have jobs requiring shift work or extremely long hours and who may be at increased risk of accidents and errors affecting themselves or others," she said.

Klerman added that lack of sleep can affect more than a person's

alertness and performance. It can impact overall health. Lack of sleep is associated with an increased risk of obesity, pre-diabetic conditions, reduced response to vaccines and changes in cardiovascular functions.

The mathematical modeling effort is one of several projects being conducted by NSBRI's Human Factors and Performance Team to improve sleep and scheduling of work shifts, as well as determining which specific types of lighting can improve alertness and performance during spaceflight.

Provided by National Space Biomedical Research Institute