COMMENTARY

Sleepiness and Driving: Multidimensional Legal, Social, Technological, and Biological Challenges

Commentary on Burks et al. Nonadherence with employer-mandated sleep apnea treatment and increased risk of serious truck crashes. *SLEEP* 2016;39(5):967–975.

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A recent office visit in my sleep clinic did not go well. The mildest statement the patient had to share was, "This apnea thing is all a fraud!" My 56-year old male trucker was there under protest. Though denying sleepiness, he had been screened as high probability for sleep apnea, and had been unwillingly forced to undergo an employer-mandated polysomnogram, showing severe apnea. Continuous positive airway pressure (CPAP) worked well enough in the laboratory, but data tracking showed minimal use. He was simply unwilling to use therapy for a disease that did not bother him. Our negotiated settlement was that he try to actually use the CPAP, or consider an oral appliance as an alternative. He was never successful, and did not return to clinic (but returned the equipment).

Driving is a complex cognitive-sensory-motor task, placing demands on multiple body systems from neural to musculoskeletal. At the neural systems level, primary sensory, visual motion, attention, and motor skill learning are key, with plasticity of neural networks demonstrable with exceptional skills or high experience.[1,2] Even the most experienced drivers are not immune to the effect of attentional loss or diversion, for example, texting while driving, or abnormalities of vision. There is little margin for error to prevent a moving vehicle from becoming an unguided and lethal missile.

The paper by Burke et al. in this issue of *SLEEP* raises a host of challenges.[3] The article summarizes some of the important background data on sleepiness and driving, especially that associated with sleep apnea. Suffice to say that the problem is large and real. At face value, this paper is a simple confirmation of what is generally suspected—that effective treatment of sleep apnea brings down driving risk similar to those without apnea. It is probably impossible to do a true randomized prospective trial of CPAP vs. placebo CPAP in those with substantial sleep apnea who operate vehicles, commercial or not. The usual issues for sleep apnea studies with longitudinal outcomes and tracking, such as the lack of polysomnogram data across all participants including those at low risk, the method of screening, turn over during the study period, the accuracy of CPAP in treating a phenotypically heterogeneous[4] disorder, the hidden differences between compliant vs. non-compliant drivers, all distract from the value of this study. Undoubtedly there were individuals in the lower priority screening groups who had sleep apnea. Alternate therapies such as oral appliances were not offered. The typical definition of adherence used, 4 hours 70% of nights, leaves the impact of residual apnea burden unresolved, as total sleep time is not known. Drivers non-adherent with CPAP ("No Adherence" subgroup) had a crash rate for preventable Department of Transportation (DOT)-reportable crashes of 0.070/100,000 miles, or nearly 5-fold more (incident rate ratio of 4.97; 95% confidence interval: 2.09, 10.63; $P < 0.001$) than the 0.014/100,000 miles for matched controls. The absolute numbers may seem small, but here, one crash is one too many, and the multiples of miles × drivers very quickly add up. During the study period, many "No Adherence" drivers (57.5%) quit before being discharged, and current law allowed them to work elsewhere without medical disclosure.

Are we picking on long-distance truckers unfairly? According to the authors, "our results strongly support Federal regulations that would mandate OSA screening, diagnosis, and monitoring drivers' treatment adherence for all commercial drivers." However, the majority of sleepy drivers on the road are not truckers. There is no end of sleepy people on the road, from sleep deprivation, sleep apnea, narcolepsy, shift work, and sedative hang-over effects, to name a few conditions. Is the argument for all drivers to be screened for sleep apnea not on the table for fear of societal pushback and the sheer practical impossibility?

The low-hanging adherence fruit temptation. Of all the standards we use in sleep medicine, using 4 hours 70% of nights as a target for adherence as taken on an undeserved golden hue. Clearly the driver for common use of this metric is insurance payments. An analysis using total CPAP hours as a continuous measure and alternatively indexed to total subjective sleep time could have provided additional insights. There is no factoring in of time scales of recovery, individual differences of sleep apnea impact, residual sleep apnea on therapy, and total sleep time, and thus the apnea burden.[5]

Tracking options abound. Vehicles of the day are mobile computing devices, tracking metrics from speed kinetics to braking, acceleration and steering wheel turns Radar or video capture of the environment and other vehicles sharing the road, and very precise vehicular behavior can be captured. Add to that sensor technologies inside the cabin that can track eyelid closure,[6] head position/nods, steering wheel grip, and so on. Physiological variables such as body movement, electroencephalogram,[7] respiration, and electrocardiogram can also be readily recorded through the rapidly developing field of small sensors or wearables. Almost certainly sleepiness will result in highly characteristic deviations of biosensor data from the norm, computed in real time and for off-line analysis.[8] Driving simulation testing shows that advanced EEG analysis including using graph theory can generate fingerprints of vigilance impairments.[9,10] The question will soon be not if these metrics can be captured, but how much and how often. Real time tracking can also provide warnings to the driver and the employer. Could a signal emanate from a vehicle signifying

"sleepy driver inside"? Would self-driving vehicles make some of these concerns obsolete, enabling even a nap while driving?

Impact of the study on other clinical situations. What are the implications of this study to other disorders where driving impairment is already high, and the risk of sleep apnea substantial? Examples include post-stroke,[11,12] Parkinson disease, vascular dementia, Alzheimer disease, and multiple sclerosis. Sleep and sleep apnea management if often challenging in these conditions; can use of stimulants such as modafinil reduce risk? Ultimately, data at individual (including simulation testing) and vehicular levels will need to be integrated.

Right to privacy and job shopping. There are clear guidelines for certain conditions where the general safety and good trumps the individual's rights. Driving is so engrained in our existence that a heavy hand in not a viable long-term solution. Without formal legislation at the state or federal levels, sleep care providers are left in a gray zone.

Therapy initiation. One aspect that slips under the radar is the (likely) impairment of vigilance and driving skills after a bad night in the sleep laboratory, and the first several nights of initiation of positive airway pressure therapy. Perhaps there should be a restriction to driving at this time; the data from this study allows assessment of a therapy-initiation adverse effect. The issue is also relevant to routine sleep apnea care, increasingly away from sleep centers.

Ultimately, driving entirely risk free from sleepiness and attentional fatigue is impossible. The trade-offs are a complex admixture of common sense, societal expectations, technology, privacy, reasonableness, and careful risk minimization. While sleep apnea in truckers may get the press and are a relatively captive population, the issues that the study by Burke and colleagues[3] raises are pervasive in our lives.

CITATION

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