



Strategies for the management of sleep disorders and sleep loss to improve road safety in Australia. Recommendations for consideration by the Federal Government inquiry into the National Road Safety strategy

A joint submission by the Sleep Health Foundation and the Australasian Sleep Association

Recommendations

- 1. Improve driver education about the causes, indicators and consequences of drowsy driving.*
- 2. Introduce a new law prohibiting unsupervised driving at night for young drivers, with stringent penalties for violation; and mandatory drowsy driver education.*
- 3. Validate naturalistic on-road continuous drowsiness monitoring devices in high risk populations (e.g., long/line-haul heavy vehicle drivers).*
- 4. Plan for the introduction of validated ocular based roadside testing of the drowsiness state firstly as an education tool and then as enforcement tool.*
- 5. Continued investment in the examination of blood/saliva-based drowsiness biomarkers as a critical step to achieving a roadside chemical biomarker test in the next 5 to 10 years.*
- 6. Develop clinically validated methods of identifying people with sleep disorders who are at high risk of drowsy driving, and therefore require treatment.*
- 7. Develop a regulatory framework supporting sleep disorder screening and management in high risk occupational groups.*

Background

The National Road Safety strategy was deployed in 2011 with a 19 point action plan to achieve a 30% reduction in road deaths by 2020. To date a 9% reduction has been achieved indicating that it likely this strategy will fall short of the 30% target by the 2020 deadline. This has prompted an inquiry into the National Road Safety strategy as to how best achieve

greater impact moving forward. The inquiry invites submissions that assist in the development of the priority areas for 2020 and beyond.

Sleep disorders and sleep loss are shown to be highly prevalent in the community and present as both a major health and economic burden as highlighted by the Sleep Health foundation report “Asleep on the job: Costs of Inadequate Sleep in Australia”

(www.sleephealthfoundation.org.au), launched by the Federal Health Minister Greg Hunt MP in August 2017. This document summarizes the evidence that attributes an increased likelihood of a motor vehicle accident to sleep disorders and/or sleep loss. Across the spectrum of sleep disorders the risk of a motor vehicle accident is increased from between 40% and 250% according to the specific disorder and/or study. Evidence of an association is shown to be consistently present across a number of studies.

We note that addressing sleep disorders and sleep loss did not feature prominently in the 2011 nineteen point action plan, despite prior awareness campaigning around drowsy driving. This now presents an opportunity for the Sleep Health Foundation and Australasian Sleep Association to jointly provide considerations for priority areas of the 2020 plan.

Contributions to this document were provided by prominent sleep health clinicians and academics with expertise on the effects of sleep disorders and sleep loss on driving performance and road safety. This document provides a number of recommendations, some of which have sufficient evidence for current consideration whilst others are areas under development that, if formally validated, may present innovative countermeasures to the road safety effects of sleep disorders and sleep loss beyond 2020.

Education

Recommendation 1: *Improved young driver education about the causes, indicators and consequences of drowsy driving.* This will raise public awareness, and ultimately change behaviour and attitudes towards drowsy driving. Compared to older drivers, young drivers are more vulnerable to impaired performance as a result of sleep loss (1), and are over-represented in sleep/drowsiness-related crashes (2).

There is sufficient evidence to support the trial of an education campaign focused on drowsy driving in young drivers (3). Specifically, teaching young drivers about what factors increase drowsiness (e.g., short sleep duration, time of day), what the major indicators/symptoms of drowsiness are (e.g., heavy eyelids, distraction), as well as the consequences of drowsy driving on road safety for drivers and other road users (i.e., second hand sleepiness) will change public attitudes towards drowsy driving, resulting in public support and behaviour change. Early education about drowsy driving can be implemented via campaigns at secondary schools and as part of licencing requirements. Using similar approaches, previous public health campaigns have demonstrated long-term success in educating and changing behaviour towards drink driving, being sun smart and smoking.

A successful education campaign in young drivers about the causes, indicators and consequences of drowsy driving has the potential to help this at-risk population make decisions about whether or not they are safe to drive. Furthermore, an education program targeted towards young drivers will help ensure acceptance and backing of road side testing for drowsiness in the future (see Recommendations 3, 4 and 5 below).

- Components of an effective education and awareness campaign include:
 - Use of accessible channels to target high risk groups (e.g., secondary school and licencing exam requirements for learner drivers, social media).

- Providing a clear and simple message to the public
- Using real-life stories of drowsy driving can help make the issue more relevant to the public
- Highlight the costs of drowsy-related accidents (i.e., cost in terms of economic, health, safety, productivity)

Graduated driver licensing

Recommendation 2: *Introduction of a new law prohibiting unsupervised driving at night for young drivers, with stringent penalties for violation.*

Graduated driver licensing laws allow new drivers to gain experience on the road before receiving their full unrestricted licence. In the United States (US), these laws include a prohibition on unsupervised driving (i.e., driving without a parent or guardian) at night. Night driving accounts for a large percentage (39%) of fatal accidents in young drivers in the US (3), yet the enforcement of night driving restrictions and penalties for young drivers vary between US states. In Massachusetts, as part of the graduated licensing program for young drivers, stringent penalties for violating a law prohibiting unsupervised driving at night were applied, along with the introduction of mandatory drowsy driving education for learner drivers. Following these changes, crash rates for young drivers decreased by 18.6% for the youngest drivers (aged 16 to 17 years) and by 6.7% for 18 to 19 year old drivers (4). Based on these findings, Australia should consider introducing new graduated driver licensing laws that include restrictions on unsupervised driving at night for young drivers, with strict penalties, to reduce drowsiness-related crashes in young drivers.

Drowsiness technology development and implementation

Recommendation 3: *Support the naturalistic on-road validation of continuous drowsiness monitoring devices in high risk populations (e.g., long/line-haul heavy vehicle drivers).*

Ocular measures are a strong marker of sleepiness related impairment. Wearable devices track blink rates and eye movements that are affected by drowsiness and can provide instantaneous correlates of driver performance. Commercial devices are currently available. Devices can track individual driver drowsiness over a sustained period of time for longer distance driving or screen multiple drivers for sleepiness through roadside testing. Researchers are currently working on validating continuous drowsiness detection technologies in the field to determine the ‘threshold’ to predict impairment on duty. Although this technology is currently available and adopted by some corporations for industry use, further validation is required for wider dissemination. Further on-road validation of a screening methodology are expected to be ready to inform a deployment strategy by 2020.

Recommendation 4: *Plan for the introduction of validated ocular-based roadside testing of the drowsiness state, firstly as an education tool and then as enforcement tool*

As ocular measures of the drowsiness state become validated, roadside testing of drowsiness could be introduced, first as an education tool, and then as an enforcement tool. Ocular measures are further advanced than chemical measures and a proposed methodology for their introduction into roadside screening of sleepiness is being developed by the Cooperative Research Centre in Alertness Safety and Productivity (www.alertnesscrc.com) with an expected delivery around 2020.

In addition to the development and validation of road side tests to detect drowsiness, *there is also the need to work with key stakeholders (e.g., police, state and federal government) to*

ensure roadside technology is practical and cost-effective for large scale use, and to educate the public on the testing process and requirements. Rest stops provide a good location where roadside drowsiness tests could be tested before legislation is implemented. Providing drivers with the opportunity to voluntarily have their drowsiness levels tested at rest stops will also give the public a tangible way of comprehending the proposed new limits for drowsy driving before they are formally introduced, as well as what happens if a result is determined to be over the limit. If road side testing is to be used for legislation purposes, then it is also important it supports the introduction of strict new drowsy driving laws to stimulate effective and long-term behaviour change. For instance, the effective implementation of tough Random Breath Test legislation in 1977 reduced drink driving related accidents from 49% (when it was introduced) to 15% in 2014.

Recommendation 5: *Continued investment in the examination of blood/saliva-based drowsiness biomarkers as a critical step to achieving a roadside chemical biomarker test in the next 5 to 10 years.*

Chemical biomarkers (e.g., metabolites) of alertness/drowsiness, similar to blood alcohol concentration, are proposed to be the ideal benchmark for rapid road side identification of drowsiness impairment. There are numerous chemical biomarkers that show promising results however the validation of a short list of possible biomarkers is considered a longer-term strategy that requires continued funding to support further laboratory and on-road testing.

Sleep disorder screening and treatment

Recommendation 6: *Develop clinically validated methods of identifying people with sleep disorders who are at high risk of drowsy driving, and therefore require treatment.*

Research by the Cooperative Research Centre for Alertness, Safety and Productivity, and other groups (5, 6), has suggested that each individual has a trait level of sleepiness which is made up of several endogenous factors (e.g., morningness-eveningness, sensitivity to stimulants/depressants). This trait-level of sleepiness therefore determines one's vulnerability to sleep loss (e.g., daytime sleepiness and cognitive impairment) or a sleep disorder, such as obstructive sleep apnoea. In other words, some people may have greater sleepiness and cognitive impairment than others despite the same degree of a sleep disorder (7). Therefore, working towards new and more efficient methods for phenotyping sleep disorders is needed to screen and clearly define people at high risk of drowsy driving.

Recommendation 7: *Develop a regulatory framework supporting sleep disorder screening and management in high risk occupational groups.*

The presence of sleep disorders in certain safety critical occupations is high (e.g., truck drivers, police, firefighters) (8-10), and this presents a risk to the health and safety of the public as well as individual workers. Accordingly, with the ongoing development of new screening and treatment methods aimed at accurately identifying drivers at high risk of drowsy driving, the Government and other regulatory bodies should consider their role in how these methods are implemented in occupational settings to best mitigate accident risk.

In the transport industry, self-report screening tools have shown very low levels of subjective sleepiness (11), *and therefore, caution should be exercised if using these subjective tests for licensing purposes in occupational settings* (7). The use of simple objective criteria (e.g., high body mass index, hypertension, diabetes and obstructive sleep apnoea symptoms) have proven to be feasible in screening for obstructive sleep apnoea in rail transport, achieving a

low-false positive rate (11). The clinical decision to treat safety critical workers for sleep disorders should also consider the influence on sleepiness and cognitive function in patients (7). The Maintenance of Wakefulness Test is currently used in safety critical occupations to assess sleepiness, but motivational effects can impact the results of this test when used for licencing purposes (12). *Therefore, more robust clinical measures are needed to predict the long term risk of impairments (i.e., accidents and errors) related to sleepiness at work (7).* For these safety critical occupations, further research is needed to determine the most appropriate methods to screen and treat sleep disorders, as well as identifying the best government and regulatory pathways for their implementation.



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References

1. Duffy JF, Willson HJ, Wang W, Czeisler CA. Healthy older adults better tolerate sleep deprivation than young adults. *J Am Geriatr Soc.* 2009;57(7):1245-51.
2. Pack AI, Pack AM, Rodgman E, Cucchiara A, Dinges DF, Schwab CW. Characteristics of crashes attributed to the driver having fallen asleep. *Accident; analysis and prevention.* 1995;27(6):769-75.
3. Williams AF, Preusser DF. Night driving restrictions for youthful drivers: a literature review and commentary. *J Public Health Policy.* 1997;18(3):334-45.
4. Rajaratnam SM, Landrigan CP, Wang W, Kaprielian R, Moore RT, Czeisler CA. Teen Crashes Declined After Massachusetts Raised Penalties For Graduated Licensing Law Restricting Night Driving. *Health affairs (Project Hope).* 2015;34(6):963-70.
5. Cluydts R, De Valck E, Verstraeten E, Theys P. Daytime sleepiness and its evaluation. *Sleep Med Rev.* 2002;6(2):83-96.
6. Ward KL, Hillman DR, James A, Bremner AP, Simpson L, Cooper MN, et al. Excessive daytime sleepiness increases the risk of motor vehicle crash in obstructive sleep apnea. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine.* 2013;9(10):1013-21.
7. Howard ME, O'Donoghue FJ. The hidden burden of OSA in safety critical workers: how should we deal with it? *Occupational medicine (Oxford, England).* 2016;66(1):2-4.
8. Barger LK, Rajaratnam SM, Wang W, O'Brien CS, Sullivan JP, Qadri S, et al. Common sleep disorders increase risk of motor vehicle crashes and adverse health outcomes in firefighters. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine.* 2015;11(3):233-40.
9. Rajaratnam SM, Barger LK, Lockley SW, Shea SA, Wang W, Landrigan CP, et al. Sleep disorders, health, and safety in police officers. *JAMA: Journal of the American Medical Association.* 2011;306(23):2567-78.

10. Howard ME, Desai AV, Grunstein RR, Hukins C, Armstrong JG, Joffe D, et al. Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. *American journal of respiratory and critical care medicine*. 2004;170(9):1014-21.
11. Colquhoun CP, Casolin A. Impact of rail medical standard on obstructive sleep apnoea prevalence. *Occupational medicine (Oxford, England)*. 2016;66(1):62-8.
12. Arzi L, Shreter R, El-Ad B, Peled R, Pillar G. Forty- versus 20-minute trials of the maintenance of wakefulness test regimen for licensing of drivers. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine*. 2009;5(1):57-62.