AUSTRALASIAN SLEEP ASSOCIATION Inc.

GPO Box 295
SYDNEY NSW 1043
Phone: 0500 500 701
Fax: 0500 500 702
E-mail: sleepaus@ozemail.com.au

Submission to:
HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON COMMUNICATIONS, TRANSPORT & THE ARTS

Neville Committee
Managing fatigue in transportation

Prepared by the Fatigue and Transport Working Party
(Ad hoc sub-committee of the Australasian Sleep Association)

Committee Members:

Assoc. Professor R. Douglas McEvoy (ASA President)
Dr. David Joffe (Hon. Secretary ASA)
Professor Robert Pierce
Assoc. Professor Drew Dawson
Assoc. Professor Ron Grunstein

Correspondence to:

Dr. David Joffe
Staff Physician
Respiratory and Sleep Medicine
Level 8, Main Building
Royal North Shore Hospital
St. Leonards
2065

email: djoffe@mail.usyd.edu.au

Executive Summary

This report has been prepared by the Fatigue and Transportation Working Party (FTWP), an ad hoc sub-committee of the Australasian Sleep Association (ASA). The ASA is the peak body representing scientists involved in sleep research and medical specialists practicing in the area. It is a multi-disciplinary society including scientists, public health experts, physicians, psychologists, and nurses. We have a membership of more than 300 members and are affiliated with the World Federation of Sleep Research Societies. The ad hoc sub-committee comprises members with specific research and clinical experience in the area of fatigue management and transportation.

Two members of this sub-committee have previously submitted substantial documentation to the Neville Committee. The aim of this report is not to reiterate their submissions but rather to offer an overview of the area and to advance several key themes the Working Party believes are important for the formulation of future policy and research directions.

The central issue to grasp in this enquiry is that fatigue results principally from inadequate sleep. This arises from either insufficient sleep time (e.g. from societal pressures or demanding work schedules) or poor sleep quality (e.g. from specific sleep disorders such as sleep apnea). It is the opinion of the ASA that fatigue contributes substantially to social and economic costs in the transportation industry (i.e. road, rail, aviation and marine). While the industry costs may be more readily measurable, the community and individual costs of death and injury resulting from fatigue-related motor vehicle accidents on our road system generally are also of great importance.

It is the strong view of the ASA that public policy and industry programs to manage fatigue in the transportation industry and on our roads needs to be informed by high-quality scientific evidence. Where evidence is lacking specific research programs should be developed. To-date a great deal of governmental and organisational policy has been uninformed or under-informed.

The ASA believes that, for the transport industry, fatigue should be recognised as an occupational health and safety issue. Having been accepted as an identifiable hazard, further policy development should be based on solid scientific evidence and on the advice of groups such as the Australasian Sleep Association that have specific expertise in this field. Programs to manage fatigue in the transportation may need to be industry specific. Specific criteria to be considered would need to include industry- specific advice regarding shift length and timing, and medical screening for sleep related disorders.

The ASA has identified 4 key issues for consideration by the Neville Committee. These points comprise the body of this document and are discussed in detail.

1. Fatigue should be recognised as an important occupational health and safety issue.
2. A platform for developing and refining screening for “high risk” individuals must be identified.

3. A suitable legal framework for risk management should be determined and national guidelines, uniform across all states, should be implemented.
4. A priority should be to promote adolescent awareness of the risks and costs of fatigue and driving.

The Australasian Sleep Association is ideally placed to assist in the implementation of the recommendations submitted herein. As the peak body representing the broadest cross section of scientists, researchers and medical practitioners in the fields of sleep and fatigue the Association is uniquely placed to advise on future policy and research directions.

1. Fatigue as an Occupational Health and Safety Issue

Over the last 20 years society has transformed to a 24 hour a day, 7 days a week structure. The strict nine-to-five Monday to Friday routine has, for most people, become a thing of the past. The majority of large retail firms and nearly all large manufacturing sectors now run around the clock. The expansion of domestic and international air travel has also expanded the number of shift driven workers and jet lagged travellers. The globalisation of monetary markets and the computerisation of banking and commerce have also contributed the rapid demise of orderly sleep in society.

Some industrial changes have been made to workplace practices. Expert consultation in some circumstances has been sought although this is more the exception than the rule. The current involvement of the Centre for Sleep Research in Adelaide in advising sections of the Australian Rail Industry highlight the growing recognition by some groups of the need for change to current shift arrangements and rostering in general. Changes to long-haul trucking hours highlight the conflict of interest between the public desire for increased safety and the perceived economic belief that changes may affect the earnings of drivers and haulage companies. In fact, changes to driving hours may have beneficial long term economic effects derived from increased safety. Numerous notable international incidents have spotlighted the massive societal and economic costs of time mismanagement. The Exxon Valdez accident and the meltdown of Three Mile Island are just two well-documented environmental disasters where sleep deprivation and excessive shift length could be identified as precipitants for calamity. By reducing the American data regarding the cost of fatigue related accidents to bare relevance to Australian data the calculated cost is in region of $2-4 billion. For detail regarding this calculation please refer to the submission of Prof. Grunstein page25. Additional information regarding the economic costs of fatigue related accidents in the US can be extracted from the reference in Sleep Medicine 1993 by D. Leger et al.(1)

There is clear scientific evidence from the numerous publications of Dinges, Dawson and others which demonstrate the effects of sleep loss on psychological function including delayed reaction time, judgement impairment and decline in information processing speed. As demonstrated by the work of Dawson et al this is not dissimilar to alcohol intoxication, a workplace hazard which is universally recognised as being unacceptable. Chronobiological factors (e.g. time of day effects on sleep restitution,

sleepiness and fatigue) are also critically important. The fact that rest quality differs over the day is not fully appreciated in the workplace. Daytime sleep may not refresh a night worker in the same fashion as night-time sleep. The length of the diurnal rest period therefore becomes critical to the night shift worker. Recent evidence from the Australian Medical Association Report into the workplace practices of doctors highlights other risks such as "on-call" rosters. Clear scientific evidence illuminates the problems of diminished sleep quality in on-call doctors independent of whether the phone rings or not. These are real issues confronting the health sector.

The increasing use of hypnotic medications, over the counter medications and alcohol as a sleep inducing agent reflect the societal pressures for sleep. Compounded by this is evidence that many of theses agents themselves exert chronobiological effects. Alcohol consumed during the day manifests differing effects in terms of psychomotor dysfunction and sleepiness in contrast to daytime consumption. The night worker having alcohol at shift end may be quite differently affected to his/her day shift colleague(2, 3).

The recognition of fatigue as a workplace hazard implies a mutual obligation upon the employer and employee. Accepting that workplace practices need to change in line with the growing body of scientific evidence is critical. The Australasian Sleep Association believes that the existing Australian Occupation Health and Safety legislative framework should be used to achieve these changes. Entrenched habits and social mores that underpin current unacceptable and dangerous practices need to be changed. Working longer does not imply working harder or better. Health surveys of truck drivers reveal that as many as 30-70% use stimulants. This reflects the large number of truck drivers who are exposed to unacceptable levels of fatigue. Understanding that daytime sleep is less recuperative and competes with other lifestyle pressures, and realising that prolonged night shifts, or "dog watches", are implicitly more challenging than day shifts are central to the argument that fatigue is a workplace hazard and must be addressed as such. A co-operative approach to reducing the risk from fatigue in the workplace for those in the transportation industry and for the millions of drivers on Australian roads is required. This includes employees and their unions, employers, departments of transport and road safety (e.g. Australian Transport Safety Board, Federal Office for Road Safety), regulatory bodies and law makers, and the appropriate professional and scientific organisations. The Australasian Sleep Association is willing to participate and advise in this process.

To ignore the overwhelming scientific evidence that demonstrates the risks and costs of fatigue is to do so at the peril of all workers. Acceptance of fatigue as a workplace hazard is the first important step.

2. High Risk Individuals

To reduce the impact of fatigue in the workplace and on the roads, people most at risk must be identified. This is obviously a requisite of any occupational health and safety initiative. The single most important cause of fatigue in transportation is inadequate sleep time. Data show that in the last 50-80 years average sleep time in western societies has decreased. The average sleep for 20-30 year olds in the US today is only 7.5 hours. Studies showed a decrease in sleep time of American college students of 1-1.5 hours in the 50 years between 1910 and 1963. Between 5% and 36% of people

surveyed from the general population say they are sleepy. Increasing work demands and shift work has a major impact on sleep. 3.5% of workers in the USA work night shifts and sleep on average only 5-6 hrs per day. A particular concern is that young people (18-30 year olds) appear to be at highest risk for fatigue-related driving accidents(4-6). In this group fatigue-related decrements in driving performance are often compounded by the simultaneous effects of alcohol, excessive speed and relative inexperience with driving. The Australasian Sleep Association considers that this age group should be the focus of further research and educational/ public awareness programs aimed at reducing risk behaviours (see below). The risk of fatigue when driving and the additive effects of even small quantities of alcohol to this risk need to be highlighted.

Medical disorders of sleep are another important cause of fatigue. The best studied in relation to accident risk in transportation is obstructive sleep apnea (OSA) and the relevant publications have been extensively reviewed by Professor Grunstein in his submission. Based on US data, OSA accounts for as many as 400,000 –2.5 million accidents per year. Using a similar calculation between 11 and 43 thousand accidents in NSW alone may be attributable to OSA.

While OSA alone may be a relatively small contributor when considering the total impact of fatigue on motor vehicle accidents, it is a reasonable starting model to investigate strategies of risk reduction. Given the enormous prevalence of OSA (4-10% of adult males) and the fact that more than 80% sufferers have not yet been medically identified, much could be done to identify those at risk of accidents related to sleep disordered breathing. There is little information yet on the prevalence of OSA in at risk populations (e.g. heavy vehicle drivers, pilots). Chronic sleep restriction or deprivation related to work schedules may coexist with OSA and have a multiplying effect on fatigue. A multi-centre prevalence study amongst truck drivers in NSW, VIC and QLD is currently underway. Funding of these and similar studies should be given high priority. Such work will not only identify how big a potential problem this is, but will also identify tools for screening large populations. A screening program must be cost effective and of sufficient sensitivity to select those at risk. Current guidelines for identifying at risk individuals do not clearly identify, at least in the case of OSA, thresholds for risk or methods of notification. There is state to state variation regarding notification which does not stipulate whether it is mandatory or voluntary. Without clear protocols for identifying those at risk with universally accepted rules for notification, most OSA sufferers at risk will continue to drive. In the appended documentation from Professor Pierce the ASA would like to draw attention to the need for physician and patient education regarding the dangers of driver fatigue.

Beyond sleep apnea there are several other sleep and fatigue related illnesses which may unduly increase the risk of accident or work related injury. Conditions such as narcolepsy, periodic movements in sleep, chronic fatigue and idiopathic hypersomnolence may increase individual susceptibility to accidents. Awareness in the community of these illnesses as potential driving and work hazards remains low.

Consideration of workplace screening for conditions of excessive sleepiness and fatigue is strongly recommended by the ASA. These programs need to be informed by the best available evidence and by individuals and groups such as the ASA with expertise in the field of sleepiness and fatigue. Already there are initiatives to develop tools to screen commercial pilots for slowing reflexes and drowsiness. Using a co-operative approach and scientifically valid strategies similar programs might be reasonably expanded to

other sectors of the transportation industry where the human and economic costs of fatigue- related performance failure are likely to be high e.g. interstate bus drivers, transporters of dangerous goods. The development of screening methods to identify individuals with signs of fatigue needs to go hand in hand with the development of appropriate management strategies.

3. Legal Framework

As eluded to in the previous section, there is currently a lack of uniform rules governing driving eligibility across the states and territories. This additionally contributes to a lack of universal notification criteria. Indeed, any current guidelines, particularly those governing sleep apnea, have, to-date, been drawn up without the prior consultation of the peak scientific bodies. They lack specificity and essentially open a medico-legal minefield for those practicing in the area. They are punitive in respect of the patient and make no recommendations regarding compliance with therapy as a desirable and measurable outcome.

It is the express opinion of the ASA that widespread community and expert consultation with respect to legislation in the area of fatigue is important. There is controversy regarding driver fitness regulations there is also controversy regarding the responsibilities of sleepy drivers (High Court of Australia v Jiminez). It is the recommendation of the sub-committee that a forum group including lawyers, sleep physicians, psychologists and health and safety specialists should be established to review current regulatory requirements with respect to fatigue in the workplace and driving.

4. Research, Education and Awareness

There is clear demographic evidence that the majority of motor vehicle accidents cluster in the male, 18-25 year old age group. This data is the same in North America, the United Kingdom and Australia. The major factor in determining this distribution appears to be 'risk taking' behaviour. Accidental death is the most common cause of death in this age group. While enormous resources have been spent on education in the areas of alcohol and safe sex, little or no educational resources have been dedicated to the development of educational programs in the area of fatigue. There is growing international recognition of this fact heralding new changes to adolescent education. Currently, in a number of countries (including Israel and the United States) the high school curriculum includes programs on sleep hygiene and the dangers of fatigue and driving.

It is the recommendation of the ASA that education should start at the earliest opportunity. Educational bodies should be consulted to determine the most appropriate approach to disseminating the message of fatigue at a school level and all driving school courses should include appropriate material regarding fatigue recognition and avoidance. Driving examinations should include testing of fatigue awareness in addition to the messages of alcohol consumption. Furthermore, it would be a

reasonable expectation of employers to provide fatigue education as part of any adequate harm minimisation program they are currently utilizing.

It would also be the express recommendation of the ASA that current adolescent sleep education programs be reviewed and implemented locally in consultation with educational authorities.

At present, funding in the area of fatigue management and sleep disorders in general come through many small agencies. With respect to driving there are currently at least 4 bodies including, Federal Office of Road Safety (FORS), RTA, Federal Transport Safety Group (ATSB) and ARC (human factors), which currently fund science in the area. This does not include NH&MRC or local funding agencies. There is little in the way of cross fertilisation between these groups and duplication of research is not uncommon. It would therefore seem reasonable for the forum group to assume an overview role to supervise the dispensing of funds to ensure that adequate resources are available and that research is of the highest calibre. The intention would not be to supercede current arrangements but to ensure that workers in the area are made aware of all funding opportunities as they arise. It would also be reasonable for this body to act as an advocate for researchers and a lobby group for fatigue management.

REFENCENCES

1. Leger D. The cost of sleep-related accidents: a report for the National Commission on Sleep Disorders Research [see comments]. Sleep 1994;17(1):84-93.
2. Horne JA, Baumber CJ. Time-of-day effects of alcohol intake on simulated driving performance in women. Ergonomics 1991;34(11):1377-83.
3. Horne JA, Gibbons H. Effects on vigilance performance and sleepiness of alcohol given in the early afternoon ('post lunch') vs. early evening. Ergonomics 1991;34(1):67-77.
4. McCartt AT, Ribner SA, Pack AI, Hammer MC. The scope and nature of the drowsy driving problem in New York State. Accident Analysis & Prevention 1996;28(4):511-17.
5. Pack AI, Pack AM, Rodgman E, Cucchiara A, Dinges DF, Schwab CW. Characteristics of crashes attributed to the driver having fallen asleep. Accident Analysis & Prevention 1995;27(6):769-75.
6. Horne JA, Reyner LA. Sleep related vehicle accidents [see comments]. BMJ 1995;310(6979):565-7.

APPENDED DOCUMENTATION

DRIVER SLEEPINESS:
OCCUPATIONAL SCREENING AND THE PHYSICIAN'S ROLE

Professor R. Pierce

Sleepiness, and its as well less defined synonym fatigue, is a factor in one third of motor vehicle accidents and ranks with speeding, alcohol, drugs and inattentiveness among the major causes of death and destruction on our roads. Most sleep related motor vehicle accidents occur in the small hours of the morning with a further peak around 5 p.m. and these are the times when our circadian rhythm brings sleep propensity to its highest and more than 40% of these accidents are work related (1). Currently in Australia a House of Representative Standing Committee on Communications, Transport and the Arts is holding a national inquiry gathering evidence on the links between sleepiness and driving risk.

Excessive sleepiness may result from shift-work, from poor sleep hygiene or insufficient sleep – burning the candle at both ends - or from medications such as benzodiazepines, tricyclic antidepressants and some antihistamines. It may result from a variety of medical conditions, the most important being sleep disordered breathing. This grouping is comprised of the common obstructive sleep apnoea/hypopnoea syndrome, central sleep apnoea, which occurs commonly in heart failure, and nocturnal hypoventilation, which is associated with a variety of respiratory and neuromuscular conditions. The insomnias, periodic limb movement disorder and narcolepsy account for a further smaller portion of the total community sleepiness burden. The obstructive sleep apnoea syndrome is present in a 4 % of males and 2% of females in the middle-aged Wisconsin population (2) and in 8% of males in an Australian population (3).

The evidence linking sleep disordered breathing and motor vehicle accidents (MVA) in the general population comes from 4 sources. Firstly, a number of studies have demonstrated an increased likelihood for persons with sleep disordered breathing to report an MVA in the past five years. This risk is 2 – 7 times that in the general population for all motor vehicle accidents and as high as an 11-fold increased risk for single motor vehicle accidents. These typically occur late at night, are commonly fatal and frequently exhibit a lack of preventative action e.g. braking on the part of the driver (4), (5). Some of these studies have used government records in states where accident reporting is mandatory (6), (4). In the Wisconsin sleep cohort (2), the odds ratio for MVA reports in the last five years is 3.4 for males aged between 30 – 60 years with obstructive sleep apnoea and if the apnoea and hypopnoea index is > 15 events per hour,

the OR for both genders combined is 7.3. Interestingly this relationship is independent of the presence of the symptoms of excessive sleepiness in these obstructive sleep apnoeic drivers. There is a positive relationship between severity of sleep disordered breathing and both the likelihood and number of MVA (7). One quarter to one third of subjects with obstructive sleep apnoea report having had an accident in the previous five years (3), (8), (4) and 57% of sleep apnoea subjects report habitual sleepy spells at the wheel (3), (4).

Secondly, a recent case control study, (9) performed polysomnography on patients presenting to hospital after a highway motor vehicle crash and a control group of primary care patients. They found a seven-fold increase of obstructive sleep apnoea in the highway accident victims. When the presence of obstructive sleep apnoea was combined with having consumed alcohol on the day of the accident, the odds ratio was 11 for accident victims compared with controls. A further case control study comparing sleep disordered breathing patients with hospital controls showed a 2.7 increase in MVA in the sleep apnoea patients (10).

Thirdly, a number of studies have demonstrated impaired performance on driving simulation tasks for obstructive sleep apnoea subjects compared with controls (11), (7).

Fourthly, there is clear evidence that treatment of obstructive sleep apnoea with nasal continuous positive airway pressure dramatically reduces the risk of accident, (12), (13) and the costs of hospitalisation for MVA (12) in sleep apnoea patients.

Recent attention to specific occupational groups in whom accidents are likely to cause greater harm has led to several studies of long-haul truck-drivers. One small early study (14) suggested that the prevalence of obstructive sleep apnoea in Californian long-haul truck-drivers may be as high as 46% whereas later studies (15) found a more modest over-representation of obstructive sleep apnoea amongst truck-drivers. A recent large survey of Philadelphia truck-drivers found a prevalence of obstructive sleep apnoea manifest by respiratory disturbance index (RDI) > 5 per hour of 28% (16).

Australian truck-drivers have a 16% prevalence of chronic sleepiness, as attested by an Epworth sleepiness scale score > 10. The ESS assess the traite rather than the state of propensity for sleep under a variety of commonly experienced circumstances. Thirty-three percent of these truck drivers have symptoms of excessive fatigue on medical examination (17). In the United Kingdom 8.1% of truck-drivers have an ESS score of > 10 (18). A large

survey of eastern state truck-drivers in Australia has recently been commenced and includes the ESS in a questionnaire administered to 6,000 drivers with a smaller number having laboratory polysomnography and detailed neuropsychologic testing.

In addition to truck and bus drivers, other occupational groups potentially at catastrophic accident risk are operators in the rail, shipping and air-transportation industries where early morning accident clustering is also found. In the case of aviation the general health screening and regular evaluation of flight simulation performance of commercial airline pilots already play a role in maintaining Australia's enviable air safety record.

There are a number of screening tools now available which could potentially be useful in the assessment of high risk populations. These include questionnaires regarding sleepiness and other symptoms of diseases associated with sleepiness. Two such questionnaires are the Epworth Sleepiness Scale (19) and the multivariate apnoea prediction (MAP) equation (20) which combines body mass index, age, gender and symptoms of sleep disorders and has a sensitivity of 88% and specificity of 55% for OSA. Along with direct questioning regarding sleepiness, these questionnaires suffer from problems of under reporting and the fact that many obstructive sleep apnoea patients with shortened sleep latency and attention/vigilance deficits remain unaware of their problem. These indices are related to disease severity in obstructive sleep apnoea populations but variability at any one level of disease severity is wide limiting their usefulness at predicting driving risk in the individual patient.

Although it is the gold standard for obstructive sleep apnoea, polysomnography in a hospital sleep laboratory is clearly both expensive and time consuming. Less comprehensive monitoring in the home setting is now possible using a number of systems, which assess snoring, Sa02, airflow, body movements and other physiological variables during unattended home use. Despite occasional problems with signal integrity these devices demonstrate reasonable correlation with in-hospital polysomnography and are now being deployed in screening programs. Objective measures of sleepiness e.g. the time honoured multiple sleep latency test and the more recently proposed multiple wakefulness test, which assess sleepiness and wakefulness at two hourly periods over a whole day, are cumbersome and expensive for screening purposes. Simpler test devices assessing vigilance and reaction time, e.g. the psychomotor vigilance task (21) – a ten minute task with the sensitivity to show decrements in performance across a single work shift in normal subjects and marked impairment in patients

with sleep disorders - are more suitable for screening workers in the occupational setting. Driving simulator performance and its real-life counterpart of on-road testing are another approach but again suffer from the potential for mild dysfunction to be masked by increased arousal in the test situation enhancing performance.

Time and expense preclude application of many of these measures in the general population. It is here that public education about risk of driver sleepiness is important and has been shown to be effective as in the case of the recent VicRoads Easter Campaign. This consisted of a structured video campaign with simultaneous advertisements on all Melbourne commercial TV stations and resulted in no MVA fatalities in Victoria over the 1999 Easter-break. In high-risk occupational groups however, screening tools may have a role and are starting to be evaluated. In Philadelphia, a two-stage screening program to identify sleep disordered breathing in commercial truck-drivers has been developed (16). It uses the MAP Questionnaire to stratify obstructive sleep apnoea risk prior to home nocturnal oximetry or hospital polysomnography. This program has been shown to be cost effective for detecting sleep disordered breathing in circumstances where the financial cost of missing a case is less than $20,000. Sleep disordered breathing fulfils many of the criteria required for cost effectiveness of a screening program. It is a common condition with a lengthy latent period between when it becomes diagnosable and when it presents clinically. Screening tools are available, to make the diagnosis and effective treatment is available and carries a favourable prognosis for long-term benefit and survival. Further studies to evaluate screening programs in high-risk occupational groups are urgently needed.

A further and equally important issue in relation to driver sleepiness is that of legal responsibility. Legal opinion in Australia at the present time is that in the case of accidents in which obstructive sleep apnoea is a causative factor, liability extends to the driver who has excessive daytime sleepiness in the context of widespread public knowledge regarding sleep disorders driving risk. It also extends to the employer of a driver with sleep disordered breathing who does not have a program for screening and education of his employees and to the medical practitioner who has not warned a patient with sleep disordered breathing about accident risk. Employers, supervisors and drivers are all liable in the event of accidents caused by sleepiness due to extended shifts, or in adequate breaks between shifts. The National Road Transport Forum has developed a “chain of responsibility” concept which includes the employer, the load consignor and the work shift designer in transport companies as well as the

driver of the vehicle in responsibility for driving behaviour and this will be brought into legislation in the near future (NRTC report).

The Australasian Sleep Association has recently drafted guidelines for medical practitioners which are similar to those put forward by the American Thoracic Society in 1994 (22). These recommend that drivers with sleep disordered breathing and a history of motor vehicle accident or equivalent clinical risk who refuse or are not amenable to treatment within two months should not drive. Reporting to licensing authorities of such individuals is also advised. Reporting however, needs to be seen in the light of individual state legislation. Some states of Australia have permissive reporting in that the medical practitioner is protected in relation to disclosure of patient confidentiality. Some states in the U.S.A. have mandatory reporting. The problem with the latter is that it creates a culture where drivers under-report symptoms and fail to seek help for fear of losing their licence. There is a need for a legal framework which encourages individual drivers with excessive daytime sleepiness to seek medical advice, investigation and treatment and which encourages employers in the transport industry to develop awareness and screening strategies for their workers.

Much attention and resources are currently being devoted to evaluating counter measures for driver sleepiness. Counter measures such as rumble shoulder strips on highways and the promotion of "power napping" strategies to restore alertness when sleepy are examples of this. Many technological devices are also under development which detect driver sleepiness behaviour in terms of eye movements and blinks, eyelid closure, head droop, steering-wheel reversal etc and which are linked to and trigger an alarm system to alert the drowsy driver. Careful evaluation of such measures is clearly important before their widespread use is commercially developed.

Sleep disordered breathing, independent of symptoms of excessive sleepiness, is associated with increased accident risk. The risk increases with severity of the condition but varies considerably between individuals with similar RDI levels. Similar dose response and variability exist for the effects of alcohol on driving performance but there is no doubt that 0.05% legislation and driver breath testing have dramatically reduced the road toll in recent

years. It is conceivable that similar legislative strategies for driver sleepiness and SDB may have some role to play in further reducing the road toll.

Clearly the role of the physician is to recognise, investigate and treat sleep disordered breathing and other causes of excessive sleepiness and to make known to the patient the driving risks involved. Sleep disordered breathing is treatable and there is clear evidence that treatment not only improves symptoms but reduces accident risk. Increased awareness on the part of primary health care providers of the role of sleep disordered breathing in motor vehicle accidents is another important step in this process and critical in reducing the human and resource cost of accidents which in the U.S. alone have been estimated at $150,000,000,000 annually. (Reference:) National Highway Traffic Safety Administration 1994. Comprehensive public health and occupational health strategies are required for early detection and effective treatment of sleep disordered breathing, the promotion of driver alertness and a legal framework which supports rather than hinders these programs.

Physicians need to work with industry, with legislators, the legal profession and with licensing authorities, as well as, with individual patients and to help promote public education and awareness strategies if we are to achieve the desired outcome of improved safety in all our modes of transport.

Rob Pierce
Professor Respiratory Medicine and Physiology (University of Melbourne)
Director Thoracic Services (Austin & Repatriation Medical Centre)

REFERENCES

1. Fell, D. L., and B. Black. 1997. Driver fatigue in the city. *Accid Anal Prev* 29(4):463-9.
2. Young, T., M. Palta, J. Dempsey, J. Skatrud, S. Weber, and S. Badr. 1993. The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med* 328(17):1230-5.
3. Bearpark, and H. 1990. Road safety and pathogical sleepiness; The role of sleep apnoea. Consultant report 3/90. Road Safety Bureau RTA. August.

4. Haraldsson, P. O., C. Carenfelt, H. Laurell, and J. Tornros. 1990. Driving vigilance simulator test. *Acta Otolaryngol (Stockh)* 110(1-2):136-40.

5. Findley, L., M. Unverzagt, R. Guchu, M. Fabrizio, J. Buckner, and P. Suratt. 1995. Vigilance and automobile accidents in patients with sleep apnea or narcolepsy. *Chest* 108(3):619-24.

6. George, C. F., P. W. Nickerson, P. J. Hanly, T. W. Millar, and M. H. Kryger. 1987. Sleep apnoea patients have more automobile accidents [letter] [published erratum appears in Lancet 1987 Aug 29;2(8557):524]. *Lancet* 2(8556):447.

7. George, C. F. P., C. Boudreau, and A. Smiley . 1996. Simulated driving performance in patients with obstructive sleep apnoea. *Crit Care Med* 154.

8. Gonzalez-Rothi, R. J., G. E. Foresman, and A. J. Block. 1988. Do patients with sleep apnea die in their sleep? *Chest* 94(3):531-8.

9. Teran-Santos, J., A. Jimenez-Gomez, and J. Cordero-Guevara. 1999. The association between sleep apnea and the risk of traffic accidents. Cooperative Group Burgos-Santander .*N Engl J Med* 340(11):847-51.

10. Wu, H., and F. Yan-Go. 1996. Self-reported automobile accidents involving patients with obstructive sleep apnea. *Neurology* 46(5):1254-7.

11. Findley, L. J., M. Fabrizio, G. Thommi, and P. M. Suratt. 1989. Severity of sleep apnea and automobile crashes [letter]. *N Engl J Med* 320(13):868-9.

12. Krieger, J., N. Meslier, T. Lebrun, P. Levy, F. Phillip-Joet, J. C. Sailly, and J. L. Racineux. 1997. Accidents in obstructive sleep apnea patients treated with nasal continuous positive airway pressure: a prospective study. The Working Group ANTADIR, Paris and CRESGE, Lille, France. Association Nationale de Traitement a Domicile des Insuffisants Respiratoires. *Chest* 112(6):1561-6.

13. Barbe, J. Pericas, A. Munoz, L. Findley, J. M. Anto, and A. G. Agusti. 1998. Automobile accidents in patients with sleep apnea syndrome. An epidemiological and mechanistic study. *Am J Respir Crit Care Med* 158(1):18-22.

14. Stoohs, R. A., C. Guilleminault, A. Itoi, and W. C. Dement. 1994. Traffic accidents in commercial long-haul truck drivers: the influence of sleep-disordered breathing and obesity. *Sleep* 17(7):619-23.

15. Mitler, M. M., J. C. Miller, J. J. Lipsitz, J. K. Walsh, and C. D. Wylie. 1997. The sleep of long-haul truck drivers . *N Engl J Med* 337(11):755-61.

16. Gurubhagavatula, I., G. Maislin, and A. I. Pack. 1999. Obstructive Sleep Apnoea (OSA) in Commercial Vehicle Operators. *Sleep* 22:S7.

17. Swann, P. 1999. Heavy Vehicle Driver Health Sleep Disorders. *Austroads GR 99/3*.

18. Maycock, G. 1996. Sleepiness and driving: the experience of UK car drivers. *J Sleep Res* 5(4):229-37.

19. Johns, M. W. 1991. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep* 14(6):540-5.

20. Maislin, G., A. I. Pack, N. B. Kribbs, P. L. Smith, A. R. Schwartz, L. R. Kline, R. J. Schwab, and D. F. Dinges. 1995. A survey screen for prediction of apnea. *Sleep* 18(3):158-66.

21. Dinges, D. F., F. Pack, K. Williams, K. A. Gillen, J. W. Powell, G. E. Ott, C. Aptowicz, and A. I. Pack. 1997. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep* 20(4):267-7.

22. Strohl, K. P., 1994. Sleep apnea, sleepiness, and driving risk. American Thoracic Society. *Am J Respir Crit Care Med* 150(5 Pt 1):1463-73.