



Waking up to the effects of fatigue

An interview with Drew Dawson



Dr Drew Dawson
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Dr Drew Dawson is Dean of Research in the Division of Education Arts and Social Sciences, Professor of Psychology at the University of South Australia and Director of the internationally recognized Centre for Sleep Research, Australia's largest sleep research facility. An international authority in sleep, fatigue, biological rhythms and hours of work, he has worked extensively with key rail, road and aviation organizations around the world. Drew has helped develop policy for some of the world's largest transport networks. He has produced over 60 industry reports, published nearly 200 articles and papers and attracted over \$8M (AU) in research grants. Drew has been a consultant to over 100 major Australian companies such as BHP and Qantas.

Can you describe fatigue?

The fatigue we research is what most people understand as sleepiness, or lack of alertness. Some confuse this with physical fatigue (physical exhaustion), or the medical fatigue of conditions such as chronic fatigue syndrome or fibromyalgia. It is a difficult term because it means many things to many people. The fatigue that we are particularly interested in is primarily thought of as sleepiness.

What causes this type of fatigue?

There are several causes of sleepiness, such as lack of sleep or excessive wakefulness. It can arise from: reduced sleep efficiency associated with conditions such as sleep apnea; type 2 diabetes; or a neurological condition. Certain drugs increase sleepiness.

What about stress?

Stress can indirectly contribute to sleepiness by interrupting sleep. Stressed people tend to sleep less well and therefore tend to be sleepier, but typically the direct experience of stress is to make you alert rather than sleepy.

What are the symptoms of fatigue?

The effects are on three broad levels—physical, mental function and emotional.

Physical effects include yawning, rubbing eyes, slumped posture and increased likelihood of falling asleep.

The effect on mental function is to slow responses, so people take longer to do mental work and are more likely to make mistakes. They experience cognitive disengagement (engaging less with cognitive tasks) which increases the frequency of certain types of errors.

Emotionally, people become grumpy and unaffectionate. They are typically irritable, short-tempered, terse and uncommunicative.

Who is prone to becoming fatigued?

People who don't get enough sleep or whose sleep is disrupted will become fatigued—people with sleep apnea are a good example. People who are taking certain medication or have other medical complications also experience fatigue.

There are times in our lives when the need for sleep increases. Examples are children undergoing the growth spurt at puberty, and women after they give birth, particularly during breastfeeding. There are significant emotional and physical demands on a new mother, so they need more sleep. Our studies indicate the amount of sleep loss experienced by new mothers is not as much as everyone believes, but their need for sleep increases quite significantly. We now believe that continual tiredness is a combination of a slight decrease in the amount of actual sleep, and a significant increase in the amount of required sleep.

What are some of the impacts or effects of fatigue?

The mental effect of fatigue is to impair people's thought processes. They are more inclined to make errors or use poor judgment, increasing the likelihood of mistakes, accidents and incidents. Tired people put themselves and others at risk. On a personal level, fatigue reduces libido.

New literature suggests sleep disruption and sleep loss impair carbohydrate metabolism and exacerbate the weight gain associated with type 2 diabetes. This increases the likelihood of sleep apnea, which decreases sleep quality—a vicious cycle. There is some indication that sleep loss has long-term impacts on immune function, susceptibility to infections or illness and



increased recovery time. Early research with animal models simulating shift work shows effects on the endocrine system.

At its most extreme we know that most sleep-deprived rats will die within a couple of weeks. There is no doubt that sleep loss seriously stresses the human body. Most epidemiological studies associate sleep loss with circadian disruption (especially in shift workers). We know that shift workers are more likely to drink, smoke, eat poorly and not exercise. They exhibit more lifestyle illness, which reduces longevity and increases mortality. But is it the shift work itself or is it the poor coping mechanisms people adopt in response?

You mentioned workplace accidents as a consequence of fatigue. Do you have any statistics?

An Australian parliamentary inquiry estimated the cost to industry of fatigue-related accidents and incidents as \$1–3 billion (AU) per year.¹ This rate is similar (per capita) in the USA and Europe, costing \$50–70 billion.

Australian studies show fatigue as a significant contributory factor in around 20% of road accidents. So one in five major truck accidents is fatigue related, and of the approximately 1600 annual road fatalities, 320 deaths are fatigue related.²

Is the transport industry being proactive in screening drivers for sleep-disordered breathing (SDB)?

I am working with companies in Canada and the USA on screening programs for SDB. Large trucking companies already use effective and reasonably costed programs for identifying people at risk. However, these progressive and safety-conscious companies are a small percentage of the total industry. Some larger Australian companies are considering these programs. It is safety-conscious, typically self-insuring bigger companies who see the bottom line advantage. Also, by identifying, treating and managing their drivers they will keep their experience in the company.

This raises an interesting dilemma. If I identify a worker who is at risk but can't immediately get them into a sleep lab, what will I do? Do I stand them down from work? Who will pay their salary? If I let them drive and they have an accident, what are the legal implications?

What the estimated costs to the transport industry and society in relation to fatigue-related accidents?

The general model gives a very high ratio of indirect to direct costs, ranging from 3:1 to 5:1. For a truck (semi-trailer) accident, the direct cost is \$0.5–1M (AU). The indirect costs can be three to five times this amount. On top are loss of income, government resources spent on investigation, insurance costs and clean-up costs—not to mention potential loss of life, injuries and medical bills.

Are there any industry programs aimed at minimizing the impact of fatigue?

Most Australian states now require transport operators to have a fatigue management system. Compliance and enforcement are still weak and companies are wrestling with the process. The debate is whether compliance with working hour restrictions constitutes a fatigue safety management system. I think most would say not, as working legally with respect to driving hours doesn't necessarily imply safety—it is only one part of ensuring a safe system of work with respect to fatigue.

The current argument is that companies must do more than simply comply with regulations on driving hours. I expect we will see insurance companies become the new 'police', as they bear the cost. We have worked with Australian insurance companies to identify companies at risk of fatigue-related accidents—determining whether companies are providing adequate sleep opportunities for employees, or if they have programs to identify conditions such as SDB.

Insurers worldwide are realizing that fatigue is a risk factor and they need to adjust premiums and excesses to reflect this. Transport companies should be rewarded for reducing risk, which will do more to change fatigue management in the transport sector than regulations and policing. Zurich Insurance has a risk assessment program with a points system to determine companies' premiums. The aviation industry in the UK is also moving along this path: when easyJet instigated a fatigue management program for their pilots their insurance premium was reduced by £2.5M p.a.

How do drivers perceive responsibility for fatigue?

I think we are undergoing a change in attitudes similar to those with drink driving and seat belts. Until recently people did not see fatigue as a risk factor. People don't often get the opportunity to learn because if you fall asleep while driving, chances are you'll die. However, awareness campaigns are helping to educate the community.

If someone stays awake continuously for 20 hours, they will exhibit performance impairment equal to a blood alcohol reading of 0.05, and after 24 hours it is equal to 0.1. The level of fatigue-related impairment is a function of both how long you have been awake and the time of day at which you are awake—it ebbs and flows like a sinusoidal wave.

Community attitudes to fatigue are changing. We have been saying 'Don't Drink and Drive' for a long time—now we are also saying 'Don't Drive Tired'.

How do you measure fatigue for your research?

Our laboratory-based performance of fatigue uses a well-established instrument called the Psychomotor Vigilance Task (PVT). This tests how tired a person is by measuring response time and vigilance: as they get more tired they



miss more signals and take longer to respond. We also measure Real World Task Performance using simulators (eg, rail, jumbo jet, truck) while depriving subjects of sleep. We then record what the 'fatigue-ometer' indicates and link various levels of fatigue to changes in performance of real world tasks.

How much sleep do you need to be safe?

If you sleep for less than five hours in the 24 hours prior to starting work or driving, or for less than 12 hours in the 48 hours prior, you are probably at a significantly elevated risk for a fatigue-related incident or accident.

It is very important that individuals are accountable for driving fatigue. The interesting legal history includes the appeal of Jiminez against his culpable driving conviction in the Australian High Court in 1992.³ The defendant had a fatigue-related accident where he fell asleep, the car crashed and a passenger died. His defense argued that because he fell asleep, he was not responsible for his actions (they were involuntary) and so he could not be held criminally liable for the other person's death.

We now see that driving tired or fatigued is comparable to using drugs or alcohol—it is a state of voluntary impairment. This is being reflected in legislation, particularly in Occupational Health and Safety (OHS). The voluntary and foreseeable aspects are critical criteria in criminal or civil liability.

If I tell you to drive a truck to a destination, and I know it will take 18 hours, and I know you have been awake for

22 hours, then it's reasonably foreseeable that you will be tired, and that could lead to impairment. As your manager, I am responsible. In fact there are managers and truck drivers currently serving jail sentences. The law is now saying "you should have known better."

We believe governments should undertake a public education initiative to raise awareness about the minimum acceptable level of sleep, with slogans like "Less than 5 and you should not drive" or "Less than 4 and drive no more."

In my view the campaigns that focus on falling asleep are looking at the wrong end of the problem. If you are tired, it's too late. Effective intervention should occur much earlier. Knowing about the dangers of sleep-deprivation allows you to make an informed choice before you start driving and put yourself, and others, at risk.

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From the Editor

This issue of ResMedica discusses the latest concerns about fatigue. We look at the dangers of fatigue in today's society, particularly in transport accidents, but also in the workplace and at home. The direct and indirect costs are alarming.

We are thrilled to bring you an interview with Dr Drew Dawson, Professor of Psychology at the University of South Australia and Director of the Centre for Sleep Research. Drew has gained critical acclaim for his work and is considered a leading international authority in the areas of sleep and fatigue. We discuss with him the personal and social implications of fatigue and the changing face of insurance and transport organizations in response to this.

We highlight the signs of fatigue and suggest how to combat fatigue when planning to drive long distances—it is startling to realize that driving fatigued is like driving drunk!

We also look at the impact of fatigue from a patient's perspective. Roger London was eventually diagnosed with Cheyne-Stokes respiration (CSR) after suffering from a brain tumor. Roger talks candidly about his experiences prior to diagnosis and treatment.

An inspiring article tells how one organization—Citigroup—acted to identify and deal with the dangerous effects of fatigue on its workers.

Of course we bring you our regular features including Facts and Figures, Recent Research and Calendar of Events to keep you up-to-date.

I hope you find this issue of ResMedica both useful and informative. Don't forget you can register online at our website www.resmed.com/newsletters/resmedica.



Lisa MacKenzie
Editor

Facts and figures about fatigue

- The mean cost of a crash involving a single vehicle has been calculated to be \$51,000 (US).¹
 - The cost of a crash involving fatalities is estimated to be \$2.7M (US).¹
 - Sleepiness represents a significant risk to driving safety and may pose as great a risk as alcohol.²
 - In the USA, during the year 2000, more than 800,000 drivers were involved in sleep apnea-related motor vehicle crashes, and those events cost \$15.9 billion (US) and 1400 lives.³
 - Treating all drivers with obstructive sleep apnea (OSA) with continuous positive airway pressure (CPAP) would cost \$3.18 billion (US)—saving \$11.1 billion in collision costs and 980 lives p.a.⁴
 - Professional drivers involved in fatal accidents had a mean sleep duration of less than six hours in the 24 hours before the accident.⁵
 - Sleepiness at the wheel increases the risk of causing a traffic accident by 8.2 times.⁶
 - Researchers from the University of Helsinki found that over 20% of long-haul drivers reported dozing off at least twice while driving during the previous three months, and 17% of these drivers reported near misses due to dozing off.⁷
 - In a random sample of 3,268 Australian commercial vehicle drivers 59.6% had sleep-disordered breathing (SDB) and 15.8% had OSA, while 24% had excessive sleepiness.⁸
 - Truck drivers with SDB have twice the accident rate per mile than drivers without.⁹
 - Mean sleep duration of 20 US truck drivers in a five-day period was 4.78 hours. Fifty-six percent exhibited six non-continuous minutes of sleep (microsleeps) during their driving sessions.¹⁰
 - British figures indicate that 27% of drivers who lost consciousness behind the wheel had fallen asleep, as opposed to fainting, having a seizure, or having a heart attack—and they account for 83% of fatalities.¹¹
 - Australian fatigue-related road accidents alone could be costing the community up to \$3 billion (AU) per year, with heavy-vehicle fatigue-related accidents costing around \$300M annually.¹²
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Microsleep



Microsleep (noun)—a brief period (usually only a few seconds) in which the brain enters a sleep state regardless of the activity the person is performing at the time.¹

Microsleeps can last from a few seconds to several minutes. During this time the brain of the sleep-deprived person actually enters into a sleep state, even though it may look like they are still sitting up and paying attention.

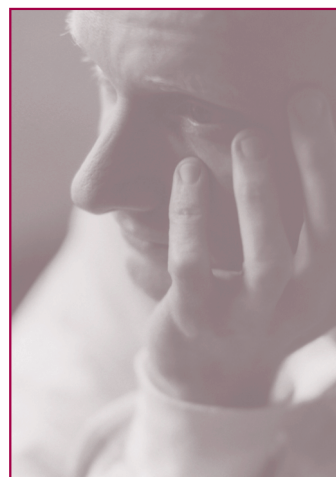
The episodes, which are completely involuntary, can be associated with a blank stare or glazed look, head snapping and prolonged eye closure. They can occur when a person is trying to stay awake to perform a monotonous task like driving a car or watching a computer screen.²

Microsleeps are more likely to occur at certain times of the day, such as the early hours of the morning, pre-dawn and mid-afternoon. During a microsleep the person fails to respond to external stimuli—they may not see a red light, or notice that the road has taken a curve.

During a study of microsleep, conducted by Dr William Dement, participants were asked to press a button when a strobe light was flashed directly in their eyes every few seconds. When they were experiencing a microsleep, the participants did not notice the light and were not even aware they had been asleep.³

If we ignore sleep and get behind the wheel of a car, a catastrophe can happen. It only takes a few seconds—just long enough for a tired body to steal needed microsleep—to run off the road or into an oncoming car.⁴

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Maggie's Law

In June 2003, New Jersey became the first state in the USA to pass a law specifically criminalizing drowsy driving. Named Maggie's Law, in honor of 20-year-old Maggie McDonnell who was killed in a head-on collision, this law makes drivers liable if convicted of causing an accident while sleep-deprived.

Maggie was killed instantly when a truck driver who had been driving 'high' on stimulants for over 30 hours to meet his delivery deadlines, fell asleep at the wheel of his truck, crossed three lanes of traffic and smashed head-on into Maggie's car.

Despite his indisputable guilt, the truck driver was only fined \$200 (US) and escaped incarceration because his defense successfully argued that there was no law against falling asleep at the wheel. Under the new legislation, law enforcement officials are able to charge individuals with vehicular homicide if, after not sleeping for 24 hours or more, they cause a fatal accident.

Driving sleepy

Sleepy drivers—an accident waiting to happen

Fatigue leads to diminished performance in many ways.

- As fatigue increases, performance and reliability decreases.
- Physical reaction times increase and thought processes become slower.
- There is a tendency to make mental errors and flawed judgments.
- False responding, or responding when a stimulus isn't present, also increases.
- Memory errors are more likely.
- Vigilance decreases.
- Motivation is reduced.

Read the warning signs. Ask yourself the following questions while you are driving:

- Are you having trouble keeping your eyes open?
- Are you blinking frequently?
- Are you rubbing your eyes often?
- Are you drifting from lane to lane or hitting the rumble strip (shoulder)?
- Are you yawning excessively?
- Are you missing turns or ignoring traffic signals (eg, failing to drive when the traffic lights turn green)?
- Are you finding it difficult to remember driving during the latter part of your journey?
- Are you literally nodding off? Are you unable to keep your head up?
- Do you startle yourself as you nod off?

If you detect any of the above warning signs while driving:

- Pull over and stop driving—have a break.
- Take a rest or nap in your car.
- Get out and stretch or walk around.
- Stop at a service station and have a snack or refresh yourself.
- Get someone else to do the driving.

Don't ignore the warning signs—pull over and “revive to survive!”

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ResMed and Citigroup

initiate a screening program



The international finance group Citigroup employs over 2,500 people in Australia, the majority in Sydney and Melbourne. Discussions with ResMed in 2005 led Citigroup to consider how it could screen its employees for OSA. Sleepiness caused by frequent arousals from sleep can affect an employee's performance at work and Citigroup's employees often make decisions involving significant sums of money, therefore they need to be operating at their peak. Alerted to this risk, Citigroup decided to encourage employees to participate in a screening program for the condition.

Citigroup decided to introduce a pilot scheme that would screen executives, with a view to eventually screening its entire Australian workforce. The pilot scheme began in May 2005, with the participation of 27 executives. They were given the Epworth Sleepiness Scale (ESS) and Berlin questionnaire to complete, and were invited to attend a lunchtime education session on OSA conducted by ResMed's medical director Dr Glenn Richards.

Each participant was given an ApneaLink™ to conduct their own overnight sleep study. The ApneaLink is a small device, about the size of a mobile phone, developed to screen for sleep and breathing disorders in a person's home. The ability to conduct the trial in their own homes made the program much more attractive to the executives.

Participants in the scheme picked up their ApneaLink on a day that suited them, took it home for a night's screening, and returned it to ResMed the next day. The results were analyzed and a confidential report, including recommendations, was returned to the participant within 48 hours. This immediate feedback helped them to understand the results of their night's sleep.

The pilot group of 27 executives ranged in age from 30–60, with an average age of 42. The pilot study was completed in seven working days. The executives found the information on sleep and SDB valuable and recommended that their staff also be made aware of the importance of good sleep and to understand the impact of SDB on performance.

In July 2005 Citigroup approved the extension of the program to all of its employees, promoted as the 'Sleep Health Benefit' plan. Under the plan, an employee can complete the ESS questionnaire and view immediate results online. Irrespective of these

results, the employee can also make an appointment for an ApneaLink test. ResMed analyzes these findings, and returns the results to the person and their nominated primary care physician. If necessary, CPAP treatment can then be recommended. The Sleep Health Benefit plan was launched at the Citigroup Employee Benefit Expo in Sydney, in August 2005. To date, 68 Citigroup employees have had ApneaLink tests.

By identifying the risk of OSA at an early stage, it's possible to avoid long-term associated conditions such as hypertension, stroke and congestive heart failure. On a daily basis, treatment for OSA can improve employees' quality of life as well as their work performance, providing mutual benefits from an employee screening program such as Citigroup's Sleep Health Benefit. ResMed hopes to work with many more employers like Citigroup, to create safer, healthier and more productive workplaces.



ResMed's ApneaLink device

Workplace accidents

The role of fatigue

In our 24-hour society, we need only drive from our home, live near railroad tracks, or board an airplane to face first-hand the potential dangers of operator fatigue. We demand that goods be shipped anywhere in the country—or around the world—overnight. Deregulation of the trucking industry might lower costs for businesses and consumers, but it may exacerbate the pressures that lead to fatigue in truck drivers.

A major cause of fatigue is loss of sleep due to changing economic and social patterns. Transport workers, under pressure to meet deadlines, “are now required to work longer, more flexible hours at reduced staffing levels. This, in conjunction with increasing task demands and social pressures, has resulted in significant reductions in the quality and duration of sleep.”¹

Research demonstrates that fatigue-related impairment is not dissimilar to the effects of moderate alcohol intoxication. “In humans, fatigue delays response and reaction times, negatively impacts on logical reasoning and decision-making, and impairs hand-eye coordination in all critical safety issues in the transport industry,”¹ thus increasing the potential to cause an accident.

According to the US National Sleep Foundation, drowsy-driving accidents cause 1,550 deaths, 71,000 injuries, and \$12.5 billion (US) in property losses and lost productivity every year. The National Highway Traffic Safety Administration reports that one million accidents annually are caused by driver inattention.

Experts attribute many on-the-job accidents in part to poor decisions and responses made by sleep-deprived workers. Lack of sleep adversely affects memory and concentration, which can impair job performance. Sleep-deprived people tend to be irritable, which can profoundly affect both personal and work relationships.

Every year thousands of sleep-deprived people are involved in road and industrial accidents. “Recent estimates suggest that fatigue-related accidents and injuries, lost production and indirect subsidies cost the Australian community over \$1 billion (AU) annually.”¹

Public awareness of drink driving is high, but the danger of sleepy or fatigued driving is less recognized. To manage fatigue at work, there should be a combined effort from employers and employees. Employers should provide a safe environment and reasonable work schedules, while employees should ensure they come to work rested and fit to perform their tasks.

The following examples of fatigue-related accidents illustrate how “fatigue-related performance failures (can result) in catastrophic outcomes.”²

Maritime accidents

Exxon Valdez

Perhaps the most expensive fatigue-related maritime accident in history was the grounding of the US supertanker Exxon Valdez on Bligh Reef in Prince William Sound, Alaska on March 24, 1989. Approximately 258,000 barrels of oil spilled when eight cargo tanks ruptured, resulting in catastrophic damage to the environment and losses to wildlife. Thankfully there was no loss of human life. While damage to the vessel and cargo amounted to more than \$28M (US), the cost of the cleanup of the spilled oil during 1989 alone was almost \$2 billion.

A cascade of errors and circumstances resulted in the accident, the most significant being the failure of the third mate to properly maneuver the vessel because of fatigue and excessive workload. Another contributing factor was the failure of Exxon Shipping Company to provide a fit master and a rested and sufficient crew.³

World Prodigy

On June 23, 1989, the oil tanker World Prodigy hit Brenton Reef, off Rhode Island, spilling over 290,000 gallons of oil over 123 m² of pristine coastline. The National Transport Safety Board (NTSB) determined the accident was caused by the master's impaired judgment from acute fatigue—he had been awake for 36 hours.⁴

Road Accidents

Bus Crash

In Louisiana on October 13, 2003, a bus crashed into a truck stopped on the road's shoulder, killing eight passengers. The NTSB attributed the accident to “the motorcoach driver's operation of the motorcoach in a reduced state of alertness due to fatigue as a result of his chronic insomnia and poor-quality sleep.”⁵

The NTSB report on the crash states that “the need for sleep varies among individuals. Losing as little as two hours of sleep a night can negatively affect alertness and performance, resulting in: degraded judgment, decision-making and memory; slowed reaction time; lack of concentration; fixation; and irritability.”

Truck collision

Just after midnight on July 27, 1994, a cargo-tank semi-trailer loaded with 9,200 gallons of propane collided with a bridge column in White Plains, New York. The tank and semi-trailer separated, and the tank fractured, releasing propane that vaporized into gas. The tank was



propelled about 300 feet onto a house, engulfing it in flames. The truck driver was killed and 23 others were injured.

The NTSB found this to be a classic example of a fatigue accident. The Board found the probable causes to be reduction in alertness of the driver, consistent with falling asleep, caused by his failure to properly schedule and obtain rest, and the failure of the company to exercise adequate oversight of the driver's hours of service.³

Aviation

Korean Airlines Flight 801 crashed in Guam on August 6, 1997, killing 227 people. Officially this crash was the result of errors by the crew, notably a lack of situational awareness resulting in "controlled flight into terrain." A senior and experienced pilot was in command of the flight. While he was not familiar with the terrain, and visibility was reduced due to rain, the approach into Guam should not have been difficult. So why did the captain lose concentration and situational awareness? When reviewing the lead-up to the flight, it was found that he had flown from Seoul to Australia, back to Seoul, to Hong Kong, and then back to Seoul again before his fateful trip to Guam, all with only a few hours of rest.⁶

Nuclear facilities

Chernobyl

The world's worst nuclear accident began in the early hours of 26 April 1986, near Kiev in the former USSR (now Ukraine). Toxic fumes spewed out from the Chernobyl nuclear plant and spread over most of Europe. The explosion initially caused over 135,000 people to be evacuated, with an additional 210,000 later resettled in a purpose-built new town.⁷ The immediate area will not be able to be inhabited for at least several hundred years.

Investigations into the meltdown showed that human error (including impaired judgment), poor design and lack of a safety culture contributed to the disaster.

Although only 30 lives were initially lost, the Ukraine Radiological Institute suggests that well over 2,500 lives have been lost since the accident, with this figure expected to reach 4,000.⁸ The true human, economic and environmental costs can never be accurately calculated.

Three Mile Island

The near meltdown at Three Mile Island nuclear power plant in Pennsylvania, on March 28, 1979, was caused by human errors, design deficiencies and component

failures. This prompted sweeping regulatory changes, in particular: identifying human performance as a critical part of safety; revamping operator training and staffing; and a "fitness-for-duty" program for plant workers.⁹

Space shuttle

The investigation into Columbia's breakup stated that "time pressure...increased the potential for sleep loss and judgment errors and that working excessive hours, while admirable, raises serious questions when it jeopardizes job performance, particularly when critical management decisions are at stake."¹⁰

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A patient's perspective



Steve Newman
CEO, Pegasus

I was always tired—I had no energy. I struggled to wake up in the morning. I would get to lunchtime, but after that I was more likely to be asleep on the desk. I had memory loss and I was finding myself becoming vague. I'd begun to feel depressed and anxious. And of

course, there was the snoring. My wife hadn't quite moved into another room, but the kids had certainly complained. At times I'd actually jump out of bed, feeling like I was choking.

One day I took my daughter to an immunologist. After talking with my daughter he started questioning me. He told me he suspected I was suffering from sleep apnea. I was indeed diagnosed with sleep apnea. I had a trial on an AutoSet Spirit™ device with a HumidAire 2i™ and a Mirage Activa™ Nasal Mask. I noticed a difference in alertness within one week. Within one month my anxiety levels had decreased, and within three months the blood clots that I had been tackling for more than a year had disappeared. Within six months I was off all asthma medication. At this point I no longer take any allergy medication for the rashes I suffered. I'm far more alert at work now—even my colleagues have noticed a difference. And we now have peaceful nights at home.

Most of my working life has been centered around the mining industry and my experiences started me thinking about how many other people may be operating heavy machinery or making safety decisions while suffering from sleep apnea.

What danger are they posing to their workmates? What danger are they posing to themselves? I'm keen to look at doing something to address the impact of OSA on safety in the mining industry.

I want everyone to have the benefit of this wonderful technology.

Websites of interest

In 1990, the American Academy of Sleep Medicine (AASM) established the National Sleep Foundation (NSF). This is an independent, non-profit organization whose mission includes improving public health and safety by enhancing understanding of sleep and sleep disorders.

www.sleepfoundation.org

The NSF believes that sleep deprivation is so great a problem that it has established a National Drowsy Driver Education Program (NDDEP) to help guide and inform people about the dangers of driving while sleep-deprived.

www.drowsydriver.org

The National Highway Traffic Safety Administration (US) also has a website that aims to "save lives, prevent injuries, reduce vehicle-related crashes".

www.nhtsa.gov

The New South Wales (NSW) Roads and Traffic Authority (RTA) website has a section outlining the causes and dangers of fatigue, and includes maps of the places within NSW where drivers can stop for a rest and a snack during holiday periods.

www.rta.nsw.gov.au/roadsafety/fatigue/index.html

The Australian National Transport Commission (ANTC) has recently proposed a policy for managing fatigue in drivers of heavy vehicles, and has published a fact sheet on Sleep Disorders and Driving.

www.ntc.gov.au/filemedia/Publications/DYHFSSleepDisordersDrivMar2005.pdf

Student Fatigue



- Up to 40% of high school and college students are sleep-deprived. Laboratory studies have documented their impaired performance due to sleep loss.¹
- High school and college students are significantly represented in crashes caused by driving while drowsy.²
- In 1913 children aged between 8–12 years slept an average of 10.5 hours per night.³ In 1964 this average dropped to 9.2 hours.⁴
- In 1994 children aged between 13–14 years slept an average of 7.7 hours per night during the week and 9.5 hours on the weekend.¹

1. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. *Child Dev* 1998;69:875–887.
2. Pack AI, Pack AM, Rodgman E et al. Characteristics of crashes attributed to the driver having fallen asleep. *Accid Anal Prev* 1995; 27:769–775.
3. Terman LM, Hocking A. The sleep of school children: Its distribution according to age and its relation to physical and mental efficiency. *J Educ Psychol* 1913; 4:138–147.
4. O'Connor AL. *Questionnaire Responses about Sleep*. Master's thesis. University of Florida: Gainesville Florida, 1964.

Methought I heard a voice cry 'Sleep no more!
Macbeth doth murder sleep,' the innocent sleep,
Sleep that knits up the ravell'd sleeve of care,
The death of each day's life, sore labour's bath,
Balm of hurt minds, great nature's second course,
Chief nourisher in life's feast.

Macbeth—Act Two, Scene II
William Shakespeare



An interview with Roger London

Roger London had the unusual experience of being diagnosed with sleep disordered breathing—twice. Here he describes how his initial diagnosis and successful treatment of sleep apnea was overshadowed by another serious condition, which ultimately required surgery. Following this, Roger's health improved so dramatically he no longer required CPAP therapy. However, after some time a deterioration in his health resulted in diagnosis of Cheyne-Stokes respiration (CSR), requiring further therapy. Roger's experiences illustrate how diagnosis and appropriate treatment can greatly improve a patient's quality of life.

Could you briefly describe some of your symptoms before your diagnosis?

The first time I was diagnosed with sleep apnea, I was working in the finance industry with a lot of stress. I was wiped out by the weekend. Then things started to change. My fingers started growing, and I put on weight. I would lose my train of thought halfway through sentences. I remember being in serious meetings at board level, and I would just lose the plot, lose track of what I was doing and what was being said. My mental sharpness was fading fast. Things that should have flowed easily, no longer did.

My energy levels, productivity, enthusiasm and outlook were all low; I seemed somewhat depressed. There is a considerable lack of confidence and tremendous self-doubt when your brain does not function how it used to. I was used to being a fairly extrovert energetic individual. I put these changes down to workload pressures and stress at the time.

I would find myself on the weekends saying "Oh no, I have to do the lawns." I would put off doing them, or I'd do a bit here and there. Just pushing the lawnmower up a slight incline was tiring.

I was progressively slowing down, significantly slowing down!

Did a doctor diagnose you with anything?

We visited numerous doctors including mainstream, alternative and naturopathic. We finally began to suspect sleep deprivation and went to my GP (PCP) who referred me to a sleep laboratory. I had a sleep study and was put onto a fixed CPAP machine. That gave me great relief for about two years but I became intrinsically tired again and I was not

bouncing around feeling energetic. I progressively slowed down again.

You mentioned that your fingers were growing—do you mean swelling?

Well no, they were becoming stiffer and they felt strange. My wedding band no longer fitted. My face also became thicker.

What happened next?

In 1992 my GP finally suggested a blood test and checked my hormone levels. Results indicated the worst. I was diagnosed with a brain tumor. I had had it for ten years, which was pretty insidious. As a consequence I developed acromegaly, which was what had caused some of my features to grow and my body to change. Luckily I had the tumor successfully removed without any residual neurological trauma.

It was just unbelievable how I changed within three to four months of the tumor being removed—I shed weight, my face thinned and my energy levels returned to normal. Life became interesting again and I no longer used CPAP.

Can you describe what led you to use CPAP again?

Over the last three to four years my wife and I endured a number of very stressful events. I seemed to get through this, but I began to slow down again. I think this became very evident to my wife during 2002. She kept saying "you're not as sharp as you used to be" and of course I would reply "no, no I'm fine, I just need a little rest." I am an academic lecturer, I was doing three degrees at once plus a long-term research project. Naturally this takes a great deal of reading, study and a lot of mental endurance and I was beginning to tire quickly.

I soon came to the realization that I was struggling. We ended up taking a vacation in Switzerland, but I was very tense when I did not need to be. I continued to wake every night to urinate, and I really had very broken sleep. When we came home from the trip my wife said strongly that she believed there was something very wrong, while I was thinking that I just needed to get fit. Then my blood pressure began rising and I suffered an attack of palpitations—my heart was rippling like a keyboard. I thought I was not going to live through it! To add to



the problem, my wife also noticed that I stopped breathing during my sleep. Eventually we decided I should check to see if the sleep apnea had returned.

So you underwent another sleep study?

I obtained a referral from my GP and undertook an ambulatory study at home. This was much easier, less invasive and more convenient than staying overnight in a sleep lab. I was not 100% convinced that I had sleep apnea so I tried proving to myself that this was wrong, by wearing Breathrights during the study at a certain time during the night. I was wrong. When they showed me the printouts I could not believe what I saw—my breathing pattern was all over the place. I was told I had Cheyne-Stokes respiration (CSR). I think that seeing the examples of my breathing helped me to understand what was going on during my sleep. I then realized that this was more serious than I had originally thought. I was advised to trial the AutoSet CS™ 2.

What was your experience of using the device?

The first night's sleep was WOW, it was bloody glorious! It was amazing waking up feeling energized for the first time in a long time. Within the first week I was beginning to really move and feel much better. I have been using the device for almost two months now and the most profound changes have come over the past few weeks. My pulse is becoming regular and my blood pressure has come down considerably: systolic from 160 to approximately 125–120 and diastolic from 105-ish to the 80s. My motivation, energy and enthusiasm have improved considerably. I am back on track with my research and work in general. My whole outlook is more positive. I used to let all the bad news from around the world weigh me down and make me feel negative, but now I see things in a more positive light.

Six months ago I would have found having all my family and kids at home difficult to cope with—now I love it, it's great. Things don't upset me like they used to. I feel very capable of accomplishing things now.

Did you encounter any problems in using the device?

Like many things, it does take time to adapt. I think the main thing I have had to sort out is where to position the coupling (hose) and mask. The mask can move out of position and if it does it results in leaks, which in turn can cause the device to sound an alarm. The alarm can then disturb my wife. When the mask is fitting well the device is very quiet and both my wife and I find it easy to sleep. While the mask leaks are not excessive, I am currently experimenting with both a full face mask and a new nasal mask.

Really I can't think of any problems. I look forward to going to sleep every night—sometimes I can't wait to get to sleep and get recharged. Now I don't wake up during the night, and I have a restful relaxed sleep.

It's been a very positive experience in my life.

Chronic fatigue/sleep deprivation can result in:

- impaired judgment
- diminished ability to concentrate
- impaired memory
- increased indecision
- increased emotional problems (including depression and anxiety)
- increased irritability/mood swings
- decreased ability to cope with stress
- increased susceptibility to colds, flu and infections
- accelerated aging
- increased risk of accidents
- increased risk of obesity, heart disease, diabetes and death.

Recent research articles

1. Working conditions and fatigue in professional truck drivers at Israeli ports. Sabbagh-Ehrlich S, Friedman L, Richter ED. *Inj Prev* Apr 2005; 11(2):110-4.

BACKGROUND: Trucks represent 6% of all vehicles, but truck crashes account for 20% of road deaths in Israel, even though travel distances are usually short (<200 km) and overnight travel is uncommon. **OBJECTIVE:** To determine occupational and individual predictors of fatigue, falling asleep at the wheel, and its involvement in crashes with injuries and deaths in truck drivers. **SETTING AND METHODS:** We carried out field interviews of 160 port truck drivers regarding driver characteristics, workplace and driving conditions, employer-employee relations, medical conditions, sleep quality and fatigue, falling asleep at the wheel, and involvement in road crashes. **RESULTS:** The day before the interview, 38.1% of the drivers had worked more than the 12-hour legal limit. More than 30% reported recently falling asleep at the wheel, and 13% had prior involvement in a sleep-related crash. Sixty-seven drivers (41.9%) said that their employer forced them to work beyond the legal 12-hour daily limit. Involvement in a crash with casualties was associated with poor sleep quality (adjusted odds ratio [OR]=2.9; $p=0.042$) and frequent difficulty finding parking when tired (OR=3.7; $p=0.049$). Self assessment of fatigue underestimated actual fatigue using the Pittsburgh Sleep Quality Questionnaire. However, fatigue occurred in many drivers without sleep problems and many crashes occurred without fatigue. **CONCLUSIONS:** Prevention requires measures to reduce work stresses, screen drivers, control speed, and modal shifts. The work risks and adverse outcomes of truck drivers in large countries with long overnight journeys occur in a small country with small distances, relatively short work journeys, and little overnight travel.

2. Sleep, sleepiness and motor vehicle accidents: a national survey. Gander PH, Marshall NS, Harris RB, Reid P. *Aust N Z J Public Health* Feb 2005; 29(1):16-21.

OBJECTIVE: To assess the role of sleep-related factors, ethnicity and socio-economic deprivation in self-reported motor vehicle accidents while driving, after controlling for gender, age and driving exposure. **METHODS:** Mail survey to a random electoral roll sample [New Zealand] of 10,000 people aged 30–60 years, stratified by age decades and ethnicity (71% response rate). The analytical sample included 5,534 current drivers (21.6% Maori men, 21.2% Maori women, 30% non-Maori men, 27.2% non-Maori women). **RESULTS:** Multiple logistic regression analyses revealed the following independent risk factors for accident involvement while driving (last three years): being younger; higher average weekly driving hours; never or

rarely getting enough sleep (OR=1.26, 95% CI 1.06–1.49); reporting any chance of dozing in a car while stopped in traffic (Epworth Sleepiness Scale question 8, OR=1.52, 95% CI 1.15–2.02); and among women, being non-Maori. Total Epworth score was not significantly related to reported accident involvement. **CONCLUSIONS:** Chronic sleep restriction, and any likelihood of dozing off at the wheel of a motor vehicle, were significant independent predictors of self-reported involvement in all types of motor vehicle accidents, not only those identified as fatigue-related. The Epworth Sleepiness Scale alone is not a reliable clinical tool for identifying individuals at higher risk of crashes. **IMPLICATIONS:** Factors relating to chronic sleepiness were as important as established demographic risk factors for self-reported motor vehicle accident involvement among 30–60 year-old drivers. The findings reinforce the need for multi-faceted campaigns to reduce sleepy driving.

3. Sleepiness of occupational drivers. Philip P. *Ind Health* Jan 2005; 43(1):30-3.

Drowsiness and sleeping at the wheel are now identified as the main reasons behind fatal crashes and highway accidents caused by occupational drivers. For many years, fatigue has been associated with risk of accidents but the causes of this symptom were unclear. Extensive or nocturnal driving was associated with accidents but few reports differentiated fatigue from sleepiness. In the early nineties, epidemiological data started investigating sleepiness and sleep deprivation as a cause of accidents. Sleepiness at the wheel, sleep restriction and nocturnal driving have been incriminated in 20% of traffic accidents. Drugs affecting the central nervous system (ie, narcotic analgesics, antihistamine drugs), nocturnal breathing disorders and narcolepsy have been also associated with an increasing risk of accidents. Treatments improving daytime vigilance (eg, nasal Continuous Positive Airway Pressure) significantly reduce the risk of traffic accidents for a reasonable economic cost. Sleep disorders among occupational drivers need to be systematically investigated. Chronic daytime sleepiness is still under-diagnosed and sleep disorders (eg, obstructive sleep apnea syndrome) are not enough explored and treated in this exposed population of sedentary males. Driver education and work schedules that integrate notions of sleep hygiene as well as promotion of sleep medicine could significantly improve road safety.



4. Sleepiness, Sleep-disordered Breathing, and Accident Risk Factors in Commercial Vehicle Drivers.

Howard ME, Desai AV, Grunstein RR, Hukins C, Armstrong JG, Joffe D, Swann P, Campbell DA, Pierce RJ. *American Journal of Respiratory and Critical Care Medicine* 2004; 170:1014-1021.

Sleep-disordered breathing and excessive sleepiness may be more common in commercial vehicle drivers than in the general population. The relative importance of factors causing excessive sleepiness and accidents in this population remains unclear. We measured the prevalence of excessive sleepiness and sleep-disordered breathing and assessed accident risk factors in 2,342 respondents to a questionnaire distributed to a random sample of 3,268 Australian commercial vehicle drivers and another 161 drivers among 244 invited to undergo polysomnography. More than half of the drivers (59.6%) had sleep-disordered breathing and 15.8% had obstructive sleep apnea syndrome. Twenty-four percent of drivers had excessive sleepiness. Increasing sleepiness was related to an increased accident risk. The sleepiest 5% of drivers on the Epworth Sleepiness Scale and Functional Outcomes of Sleep Questionnaire had an increased risk of an accident (OR 1.91, $p = 0.02$ and OR 2.23, $p < 0.01$, respectively) and multiple accidents (OR 2.67, $p < 0.01$ and OR 2.39, $p = 0.01$), adjusted for established risk factors. There was an increased accident risk with narcotic analgesic use (OR 2.40, $p < 0.01$) and antihistamine use (OR 3.44, $p = 0.04$). **CONCLUSIONS:** Chronic excessive sleepiness and sleep-disordered breathing are common in Australian commercial vehicle drivers. Accident risk was related to increased chronic sleepiness and antihistamine and narcotic analgesic use.

5. Sleep and sleepiness among Brazilian shift-working bus drivers.

Santos EH, de Mello MT, Pradella-Hallinan M, Luchesi L, Pires ML, Tufik S. *Chronobiol Int* 2004; 21(6):881-8.

The aim of this study was to evaluate daytime and night time sleep, as well as daytime and night time sleepiness of professional shift-working bus drivers. Thirty-two licensed bus drivers were assessed by nocturnal and diurnal polysomnography (PSG) recording and multiple sleep latency testing (MSLT) sessions. Sleep length was shorter and sleep efficiency reduced for daytime sleep compared with night time sleep. Thirty-eight percent of the drivers had indices of obstructive apnea and hypopnea

syndrome ($>5/h$ sleep) during night time and daytime sleep; more drivers snored during daytime than night time sleep (50% vs. 35%, $p < 0.05$), and 38% of the drivers evidenced periodic leg movements. The MSLT revealed that 42% and 38% of the bus drivers met the criteria for sleepiness when the test was conducted during the day and night, respectively. **CONCLUSIONS:** The daytime as compared to night time sleep of shift-working bus drivers was shorter and more fragmented and was associated in many with evidence of excessive sleepiness. Respiratory disorder was a common finding among the professional shift-working bus drivers. All these sleep deficiencies may adversely affect on-the-job driving performance.

6. Reducing motor-vehicle collisions, costs, and fatalities by treating obstructive sleep apnea syndrome.

Sassani A, Findley LJ, Kryger M, Goldlust E, George C, Davidson TM. *Sleep* May 2004; 27(3):453-8.

STUDY OBJECTIVES: Drivers suffering from obstructive sleep apnea syndrome (OSAS) have an increased risk of being involved in motor vehicle collisions. This study estimates for the first time the annual OSAS-related collisions, costs and fatalities in the United States, and performs a cost-benefit analysis for treating drivers suffering from OSAS with continuous positive airway pressure (CPAP). **DESIGN:** The MEDLINE-PubMed database (1980-2003) was searched for information on OSAS. A meta-analysis was performed of studies investigating the relationship between collisions and OSAS. Data from the National Safety Council were used to estimate OSAS-related collisions, costs and fatalities, and their reduction resulting from treatment. Next, the annual cost of treating OSAS with CPAP was calculated. Finally, multiple one-way sensitivity analyses were performed. **SETTING:** N/A. **PATIENTS OR PARTICIPANTS:** N/A. **INTERVENTIONS:** N/A. **MEASUREMENTS AND RESULTS:** More than 800,000 drivers were involved in OSAS-related motor-vehicle collisions in the year 2000. These collisions cost \$15.9 billion (USD) and 1,400 lives in the year 2000. In the United States, treating all drivers suffering from OSAS with CPAP would cost \$3.18 billion, save \$11.1 billion in collision costs, and save 980 lives annually. **CONCLUSION:** Annually, a small but significant portion of motor-vehicle collisions, costs and deaths are related to OSAS. With CPAP treatment, most of these collisions, costs and deaths can be prevented. Treatment of OSAS benefits both the patient and the public.



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Focus on Respiratory Care and Sleep Medicine Conference

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Helsinki, Finland

Heart Failure Congress 2006 (European Society of Cardiology)

18–23 Jun

Salt Lake City, UT, USA

APSS 20th Annual Meeting (Associated Professional Sleep Societies)

26 Jun–1 Jul

San Francisco, CA, USA

ASBS Annual Meeting (American Society of Bariatric Surgery)

30 Aug–2 Sept

Sydney, Australia

11th World Congress of the IFSO (International Federation for the Surgery of Obesity)

2–6 Sept

Munich, Germany

European Respiratory Society Congress

2–6 Sept

Barcelona, Spain

World Congress of Cardiology 2006

3–8 Sept

Sydney, Australia

10th International Congress of Obesity

6–9 Sept

Seoul, Korea

5th ASRS Congress (Asian Sleep Research Society)

12–16 Sept

Innsbruck, Austria

18th Congress of the European Sleep Research Society

19–21 Sept

Atlanta, GA, USA

Medtrade 2006

27 Sept–1 Oct

Montreal, Canada

8th World Congress on Sleep Apnea

5–7 Oct

Perth, Australia

19th Annual Scientific Meeting of the ASA (Australasian Sleep Association)

20–24 Oct

Boston, MA, USA

NAASO Annual Scientific Meeting (The Obesity Society)

21–26 Oct

Salt Lake City, UT, USA

Chest 2006

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