GHSA
Governors Highway Safety Association
The States' Voice on Highway Safety

This report was made possible by a grant from

State Farm®

WAKE UP CALL!

Understanding Drowsy Driving and What States Can Do

Contents

4 **Contributors**

5 **Introduction**

6 **About This Publication**

8 **The Drowsy Driving Problem**
9 *Crash Characteristics*
9 *Determining the Extent of the Problem*

11 **A Nation of Drowsy Drivers**
11 *Why Are We So Tired?*

13 **Who is Likely to Drive Drowsy?**
13 *College Students*
14 *Shift & Night Workers*
14 *Tired Cops & EMS Providers*
15 *Health Care Workers*
16 *Commercial Motor Vehicle Operators*
16 *People With Sleep Disorders*

18 **Reframing the Issue**
20 *Drowsy Driving is Impaired Driving*
21 *Drowsy Driving as an Emphasis Area*

22 **Drowsy Driving Countermeasures**

22 **Data Collection**

23 **Drowsy Driving Laws**

25 **Teen Driver Policies**
25 *Nighttime Driving Restrictions*
26 *Later School Start Times*
27 *A Legislative Push to Start Schools Later*
28 *Tools to Help Colleges & Universities*

29 **Driver Education & Licensing Requirements**
29 *Educating Novice Drivers*
30 *Driver Manuals & Tests*
31 *License Limitations Due to Sleep Disorders*

31 **Workplace Policies**
32 *Key Employer Groups – Truckers, Docs and Cops*
32 *Commercial Motor Vehicle Policies*
33 *Hospital Policies*
34 *Police Agency Policies*

35 **Enforcement**
36 *Training is Essential*
36 *Crash Investigation Training*
37 *Commercial Vehicle Stops*

39 **Public Awareness and Education**
40 *Online Drowsy Driving Education & Training*
40 *Sleep Education*

41 Tips for Getting a Good Night's Sleep
42 *Educating Parents of Teens*
43 *Putting a Face on Drowsy Driving*
43 **Tennessee**
44 **Massachusetts**
44 **Maine & Nationwide**
44 **Florida**
45 **Maryland & Nationwide**

45 **Engineering**
45 *Rumble Strips*
46 *Median Cable Barriers*
47 *Rest Areas*
47 *Vehicle Technology*

50 State Best Practices
50 **Iowa**
51 *Message Mondays*
52 *State Patrol Initiatives*
52 *Statewide Summit & Hy-Vee Partnership*
53 **Utah**
54 *Freeway Signage*
54 *Sleep Smart. Drive Smart Alliance*
55 *GDL Parent Nights & Driver Testing*
56 *UDOT Motor Carrier Division*
56 **Texas**
56 *Our Driving Concern*
58 **New York**
58 *Drowsy Driving Partnership*
59 *Driver Education*
60 *Later School Start Time*
62 *Law Enforcement Training*

63 Conclusion

64 References

Contributors

This report was researched and written by **Pam Fischer**, *Principal*, Pam Fischer Consulting, Hackettstown, NJ. It was prepared with the assistance of an Expert Panel that included:

Jonathan Adkins
Executive Director, Governors Highway Safety Association
Washington, DC

Dr. David Davila
Vice Chair, National Sleep Foundation,
Medical Director, Sleep Center, Baptist Health Medical Center
Little Rock, AR

Chuck DeWeese
Assistant Commissioner, New York Governor's Traffic Safety Commission
Albany, NY

Vicki Harper
Public Affairs, State Farm®
Bloomington, IL

Dr. J. Stephen Higgins*
Research Psychologist, National Highway Traffic Safety Administration
Washington, DC

Patrick Hoye
Bureau Chief, Iowa Governor's Traffic Safety Bureau
Des Moines, IA

Lisa Joyce
Public Affairs, State Farm®
Concordville, PA

Dr. Rafael Pelayo
Clinical Professor, Adults & Children Sleep Medicine Center, Stanford Health Care
Redwood City, CA

Dawn Teixeria
President & CEO, SADD, Inc.
Marlborough, MA

Ted Thurn
Sr. Health Policy & Government Affairs Analyst, American Academy of Sleep Medicine
Darien, IL

Dr. Nathaniel Watson
Immediate Past President, American Academy of Sleep Medicine
Co-Director, University of Washington Medicine Sleep Center
Seattle, WA

The report was overseen by **Kara Macek**, *Communications Director*, GHSA.
Special thanks to **Barbara Harsha**, BLH Consulting, LLC, for manuscript review.

The views and recommendations in this publication do not necessarily reflect those of State Farm, GHSA or the individuals and organizations represented on the Expert Panel.

* Served in an advisory capacity

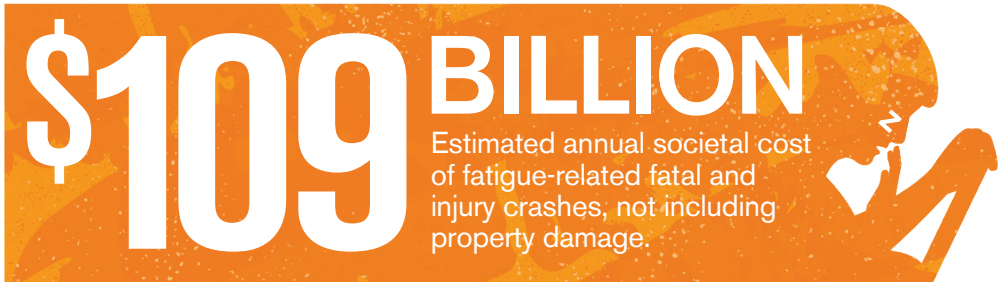
Introduction

Sleep is one of the great equalizers. Everyone needs it. In fact, experts stress that we should devote one-third of our day to catching those all important Zzzz's (U.S. Department of Health and Human Services/National Institutes of Health [NIH], 2011). However, research confirms that we simply are not getting enough sleep. According to the U.S. Centers for Disease Control (CDC), more than one-third of U.S. adults report sleeping less than seven hours a day – the optimal time needed for good health and well being (Liu et al., 2016). That means that nearly 83.6 million sleep-deprived people are in the workplace, at school and on the road.

A *drowsy* driver is an unsafe driver. A lack of sleep negatively impacts performance. It slows reaction time, impairs judgment and situational awareness, increases lapses in attention and risk taking as well as the potential to micro sleep – literally dozing off for a few seconds while driving (National Safety Council [NSC], 2016; Czeisler & Baldino, 2015; Rosekind, 2012). To compound the problem, being tired impairs our ability to judge just how tired we really are. While one in four motorists has admitted to driving at least once during the past month when they were so tired they could barely keep their eyes open (Arnold & Tefft, 2015), is that self-reported assessment truly accurate?

The decision to get behind the wheel or stay on the road despite feeling drowsy can be deadly. According to the National Highway Traffic Safety Administration (NHTSA), from 2009 to 2013 there were more than 72,000 police-reported crashes involving drowsy drivers, injuring more than an estimated 41,000 people and killing more than 800 (National Center for Statistics and Analysis [NCSA], 2011). However, there is agreement that drowsy driving is significantly underreported. An AAA Foundation for Traffic Safety (AAA Foundation) analysis of data from NHTSA's NASS Crashworthiness Data System estimates that 7% of all crashes and 16.5% of fatal crashes involved drowsy driving (Tefft, 2014). That translates to more than 5,000 people dying in drowsy-driving crashes last year.

In March 2015, the NHTSA Administrator announced that the federal agency, which is tasked with addressing behavioral safety issues, would take a comprehensive approach to preventing the tragedies attributed to driver drowsiness or fatigue (Rosekind, 2015). Later in the year, representatives from traffic safety, public health, law enforcement and advocacy organizations, along with academia and business convened in Washington for a series of meetings to discuss what to do about the problem. From defining what it is to identifying potential countermeasures, many individuals and organizations discussed not only the significance of driving drowsy, but also the need to adopt a new approach to solving it.



Source: NHTSA analysis for GHSA

Joining the call for a solution, the National Transportation Safety Board (NTSB), which conducted approximately 36 major investigations involving fatigue between 2001 and 2012, added human-fatigue to its current list of most wanted transportation safety improvements (2016). In addition, the U.S. Department of Health and Human Services' *Healthy People 2020* program, the nation's roadmap for better health, includes sleep as a priority initiative and calls for a reduction in drowsy driving crashes coupled with an increase in the proportion of high school students and adults who get sufficient sleep (U.S. Department of Health and Human Services [HHS], 2010; HHS 2016).

Clearly, the nation's lack of sleep and its impact on driving is a bona fide public health and safety threat. The challenge is engaging the public in a dialogue that ultimately prompts behavior change.

About This Publication

This publication is one of a series funded by State Farm®. The report is intended to help Governors Highway Safety Association (GHSA) member State Highway Safety Offices (SHSOs) and their partners better understand the cause and effect of drowsy driving and identify how best to address it in their respective states and/or communities. It explores what is known about the extent of drowsy driving, the crash characteristics, who is most at risk, and the challenges associated with combating the problem. The restorative value of sleep and the vital role it plays in our personal health and safety are discussed including how much is needed and the factors and medical conditions that impact it. Drowsiness as a form of impaired driving is addressed with an eye toward reframing the issue so that driving without adequate sleep is deemed just as dangerous as driving drunk, drugged or distracted.

Countermeasures – policies, programs (education and enforcement), and engineering solutions – being employed at the federal, state and local level as well as in-vehicle technologies available today or on the horizon, are examined. However, this report is not intended to be inclusive of all drowsy driving-related policies or initiatives, nor does inclusion of a particular program or policy imply endorsement. For example, while the report identifies commercial vehicle operators as a group at-risk for driving fatigued and briefly discusses policy and tactics, it does not delve into the current regulatory environment. That topic is well beyond the scope of this publication.

Some of the policies and programs included in this report were identified through a survey of SHSOs conducted by GHSA in February 2016. Thirty-three states and the District of Columbia (D.C.) provided responses about their drowsy driving data-collection efforts, laws and enforcement (including training), programs, and partners. After reviewing survey responses and consulting with an expert panel of federal and state highway safety officials, public health and safety advocates, and researchers, telephone interviews were conducted with a select number of states and individuals to gain a better understanding of their activities. The drowsy driving activities of four of those states are highlighted in a separate section to illustrate how they are implementing particular education, enforcement, data collection, policy, and/or engineering countermeasures discussed in this publication. Some, but not all, of the initiatives have been or are being evaluated through crash data analyses, pre- and post-surveys or peer review, which are essential for gauging impact and informing future efforts.

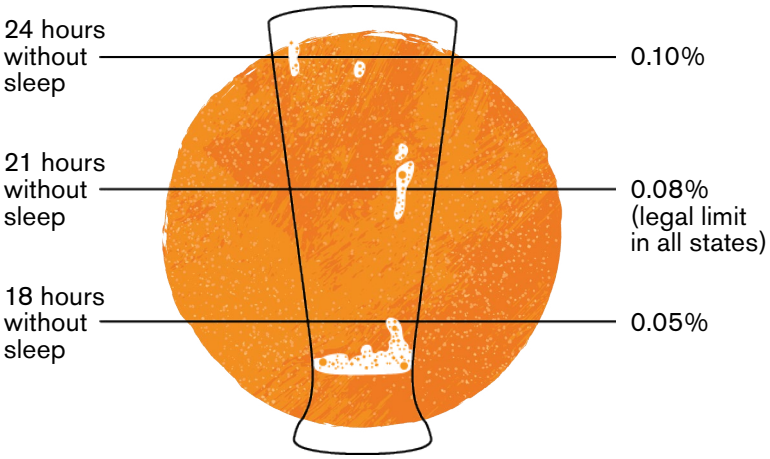
Drowsiness as a form of impaired driving is addressed in this report with an eye toward reframing the issue so that driving without adequate sleep is deemed just as dangerous as driving drunk, drugged or distracted.

Understanding Drowsy Driving by the Numbers

>50%

Drowsy driving crashes involving drivers age 25 and younger

Lack of sleep mimics blood alcohol concentration



328,000

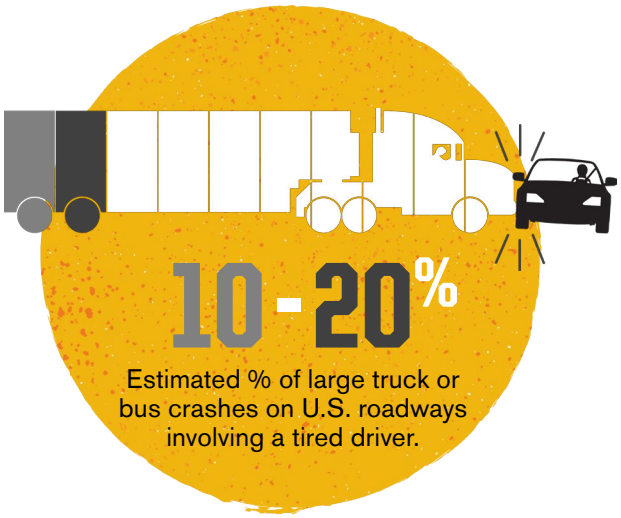
Avg. annual # of drowsy driving crashes on U.S. roadways

109,000

Avg. annual # of injury-related drowsy driving crashes on U.S. roadways

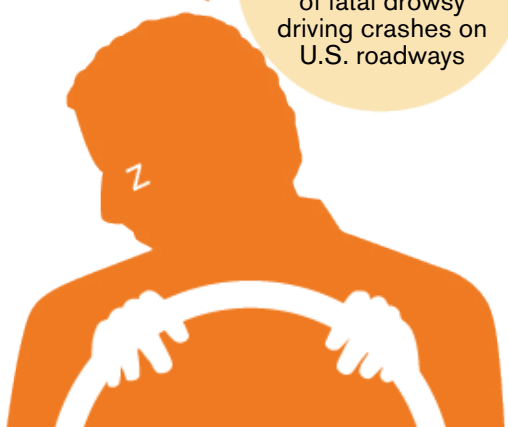
6,400

Avg. annual # of fatal drowsy driving crashes on U.S. roadways



10 - 20%

Estimated % of large truck or bus crashes on U.S. roadways involving a tired driver.



The Drowsy Driving Problem

Sleepiness or drowsiness is defined as the need to fall asleep. You cannot fight sleep. Your body demands it due to homeostatic (the biological need to sleep) and circadian (our internal body clock that operates on a 24-hour cycle) factors (National Highway Traffic Safety Administration, [NHTSA], 1998). Sometimes the term fatigue is used interchangeably with drowsiness or sleepiness. Fatigue, which results from "physical labor or a prolonged experience," is defined as a "disinclination to continue the task at hand" (NHTSA, 1998).

When it comes to driving drowsy, a tension arises between the disinclination to drive and the need to drive. When that occurs, the driver's attention to the task of safely operating the vehicle diminishes. A moderately drowsy driver typically exhibits slack facial muscles, limited body movement and reduced eye scan. A severely drowsy driver will exhibit these same characteristics along with extended eye lid closures and difficulty keeping his or her head up (Wierwille and Ellsworth cited by Klauer et al., 2006). Inattention, meanwhile, can be caused by fatigue, but also by distractions occurring inside and outside the vehicle. This report focuses on sleepy or drowsy driving, which researchers suggest is "identifiable, predictable and preventable" and not drivers who are inattentive or distracted (NHTSA, 1998).

Crash in Bed, Not on the Road

Drowsy driving is no joke. A sleepy driver is just as a dangerous as a drunk driver. The National Institutes of Health (NIH, 2011), of the U.S. Department of Health and Human Services, and AAA (2016) offer the following life-saving tips for avoiding drowsy driving:

- **Be well rested before hitting the road. Several nights of fewer than 7-8 hours of sleep slows your reaction time, resulting in a sleep debt. It may take several nights of being well rested to repay that debt and make you ready for a long road trip.**
- **Avoid driving between midnight and 7 a.m. and in the mid-afternoon, times when we are naturally the least alert and most tired.**
- **Do not drive alone. If possible, travel with a well-rested passenger who can engage you in conversation and share the driving.**
- **Schedule frequent breaks on long trips; stop every two hours or 100 miles.**
- **Do not drink alcohol. Just one beer when you are sleep deprived mimics the effect of two or three when you are well rested.**
- **Do not rely on caffeine to keep you awake.**

Crash Characteristics

A motorist who has been awake for an extended period of time will likely experience performance deficits similar to that of someone who has been drinking. For example, a motorist who is up for a continuous 18 hours will typically exhibit performance levels similar to that of a person with a Blood Alcohol Concentration (BAC) level of 0.05%. After 21 and 24 hours without sleep, performance mimics a BAC of 0.08% and 0.10%, respectively (Dawson & Reid, 1997; Arnedt et al., 2001). Unlike drunk driving, there is no subjective or objective tool – a sleep breathalyzer – available to help law enforcement detect if a crash was the result of a driver operating on too little sleep. Drowsy driving crashes, however, typically exhibit the following common characteristics:

- **They occur late at night, in the early morning hours or in mid-afternoon.**
- **They are likely to result in serious injury or death.**
- **They involve a single vehicle leaving the roadway.**
- **They occur on high speed roadways.**
- **They involve a driver traveling alone.**
- **There is no evidence of braking.**

Drowsy driving crashes often occur on rural roads and highways, where there can be long, monotonous stretches of blacktop. The time of day when drowsy driving crashes are likely to occur is reflective of when the body experiences a dip in circadian rhythm. Even when drowsy drivers do not crash, nearly a quarter admit to running off the road (McCartt et al., 1996, as cited in Schultz & Young, 2007).

Determining the Extent of the Problem

The extent of the drowsy driving problem is not fully known. Current estimates of motor vehicle deaths caused by a drowsy driver range from 2 to 20% (Rosekind, 2015). According to NHTSA, between 2009 and 2013, there were more than 72,000 police-reported crashes involving drowsy drivers resulting in an estimated 41,000 injuries and 800 deaths (NCSA, 2011). But, there is agreement among researchers, practitioners and advocates that far more crashes are likely the result of drowsy drivers.

Historically, the problem has been measured through an analysis of police reported crashes that list drowsiness as a contributing factor with prevalence ranging from 1% to 4% (Knipling, Wang & Goodman as cited in Arnold & Tefft, 2015). This low rate is likely the result of law enforcement officials not recognizing the signs of drowsy driving coupled with a lack of protocols and training. In addition, self-reports of driving while drowsy and falling asleep at the wheel are likely underreported. That is because fatigue clouds judgment making it difficult for a driver to adequately recognize and assess drowsiness. If a driver did fall asleep while driving, but suffered no negative consequences, the unsafe event was likely not captured. A drowsy, crash-involved driver may also fail to report the true causation factor due to concerns about monetary

penalties, motor vehicle points, and/or higher insurance premiums.

To get a better understanding of the problem, researchers at the AAA Foundation conducted an in-depth data analysis of a representative sample of crashes where the vehicle was towed from the scene and learned that the "drowsiness status of nearly half of all drivers was reported as unknown" (Arnold & Tefft, 2015). With this information, they developed a statistical model to determine the percentage of drivers who were drowsy. Applying that model to 2009-2013 crash data, they estimated that drowsy drivers were involved in 6% of all crashes in which a passenger vehicle was towed, 13% of crashes that resulted in a hospital admission, and 21% of fatal crashes (Tefft, 2014). Applying these rates to "all reported crashes nationwide, suggests that an average of 328,000 crashes annually, including 109,000 that result in injuries and 6,400 fatal crashes, involve a drowsy driver" (Tefft, 2014).

Naturalistic studies, such as the 100-Car Naturalistic Driving Study which tracked the behaviors of drivers in 100 vehicles equipped with video and sensors over a 12-month period, also help to paint a more realistic picture of the extent of the drowsy driving problem (Klauer et al., 2006). Building on this study, researchers are now delving into the SHRP2 (2nd Strategic Highway Research Program) data set, which includes detailed information for 3,400 drivers in six states. The available pool of data – more than 5.4 million driving trips that includes information on approximately 36,000 crashes, near-crashes and other driving events – is enabling NHTSA and its partners to establish more reliable and valid estimates of the risk and incidence of drowsy driving through the development of statistical models and other tools (Virginia Tech Transportation Institute, 2016; NHTSA 2016). For example, the drivers who were observed to be drowsy in the SHRP2 study were 3.5 times more likely to be involved in a crash than those who were not drowsy (Dingus et al., 2016).

[It is estimated that] drowsy drivers were involved in 6% of all crashes in which a passenger vehicle was towed, 13% of crashes that resulted in a hospital admission, and 21% of fatal crashes.

A Nation of Drowsy Drivers

The percentage of drowsy motorists on the nation's roadways has not changed in over a decade. According to the 2015 *Traffic Safety Culture Index* conducted by the AAA Foundation, a third of all drivers (31.5%) admitted to driving within the past 30 days when they were so tired that they had trouble keeping their eyes open (that compares to 37% in 2002). A small but still concerning percentage (3.5%) of these drivers said this occurred *fairly often* or *regularly* (Arnold & Tefft, 2015). Even more troubling is the finding that two in five drivers (43.2%) said they fell asleep or nodded off while driving at least once in their life. A closer look reveals that one in seven drivers (14.5%) admitted to falling asleep at least once, 11.3% said it occurred twice, and 17.4% indicated three or more times. Meanwhile, 2.5% of motorists said they had fallen asleep while driving in the past month, 6.6% within the past six months, and 10% within the past year (Arnold & Tefft, 2015).

This problem appears to be more prevalent in men than women (51.1% versus 35.5%), with the former having done so within the past year at a higher rate (11.9% versus 8.2%). When age is considered, 19- to 24-year-old drivers are more likely than any other age group to struggle to keep their eyes open, while 25- to 39-year-olds represent the greatest number of drivers (5.3%) who experience this fairly often. Young adults were also more likely than any other age group to report having fallen asleep while driving within the past month (4%), past six months (12%), and past year (20.4%). There is some good news though; the problem appears to decrease with age (Arnold & Tefft, 2015). No driver, however, is immune.

Why Are We So Tired?

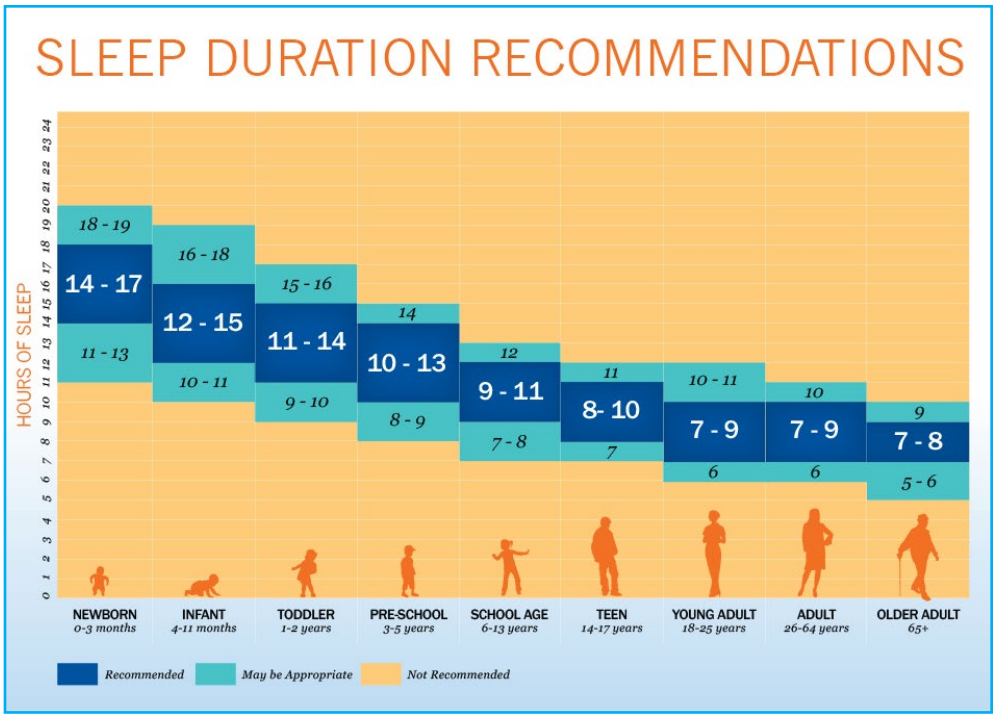
Sleep and how much of it we are getting play a critical role in understanding the drowsy driving problem. A good night's sleep – at least seven to eight hours for adults and eight to ten for teens and young adults – helps you be more alert and focused, which is essential for safe driving (NIH, 2015; Rosekind personal communication, 2016). But newly released findings from a CDC study of self-reported sleep length, found that 34.8% or 83.6 million U.S. adults are getting less than seven hours a day (Liu et al., 2016). (See the pull out box for more information.)

Interestingly, respondents to the AAA Traffic Safety Culture index were asked how often they slept less than *six hours a night in a typical week* rather than *seven*. The findings confirm that drivers are not getting sufficient sleep and when that

Who You Are, Where You Live Impacts Your Sleep

A CDC study (Liu et al., 2016) found that people who are over age 65, married, employed, have a college degree and are white, Asian or Hispanic, are more likely to get the recommended amount of sleep. Native Hawaiians/ Pacific Islanders, Black, Multiracial, and Native Americans/Alaska Natives all reported less sleep – fewer than 60% got at least seven hours a day. Unemployed people also had lower healthy sleep rates (60.2%).

Geography also correlates with sleep. People who live in Great Plains states had the highest rates of healthy sleep duration, while those in the Southeastern states and the Appalachian Mountains region had the lowest.



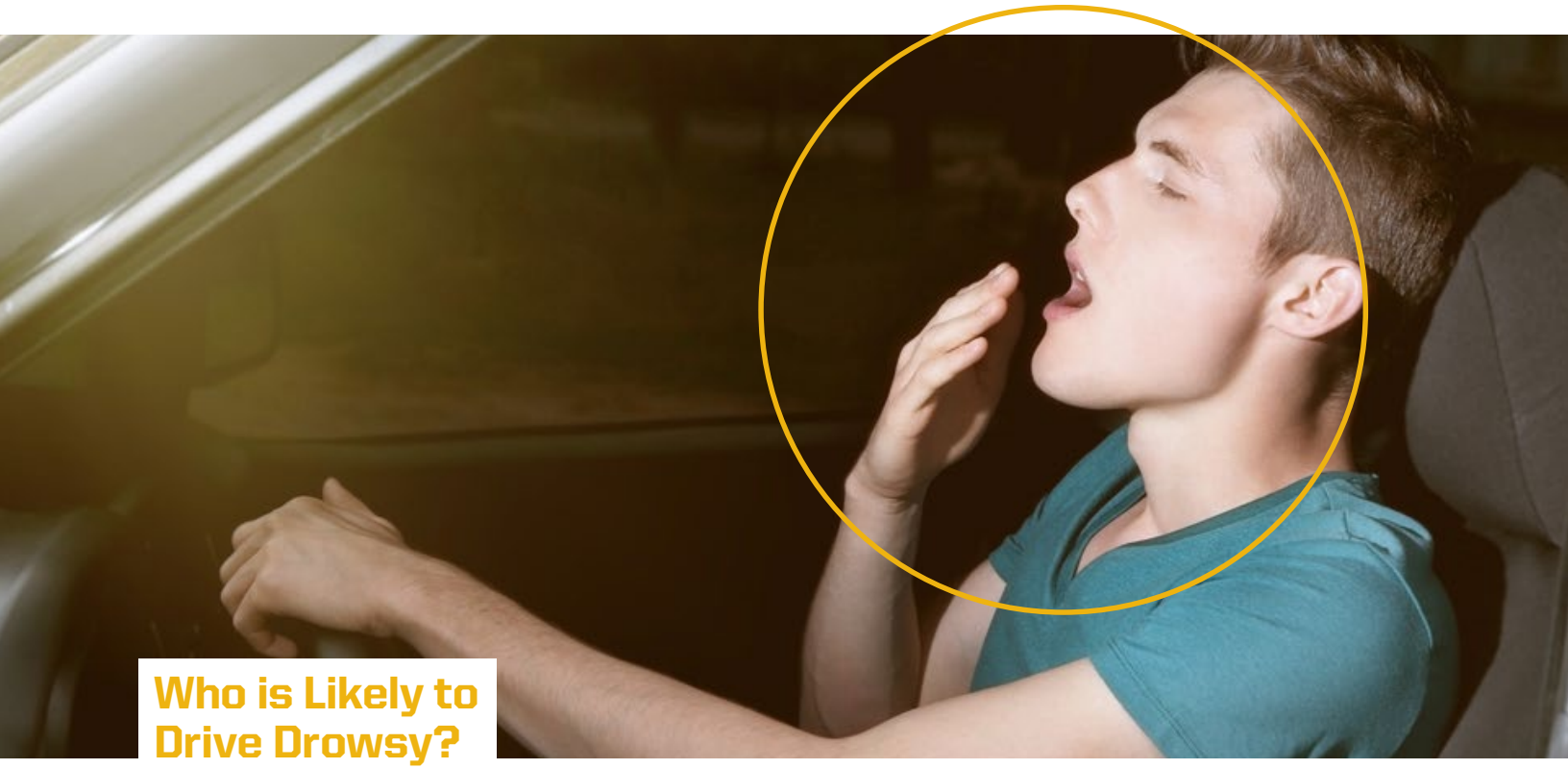
Source: National Sleep Foundation

occurs they are more likely to report falling asleep when driving. Not surprisingly, the rate of falling asleep while driving increases as motorists reported sleeping fewer six-hour or more days in a week, when compared to their counterparts who reported sleeping at least six hours a day every day (Arnold & Tefft, 2015).

Motorists who fail to get adequate sleep over a series of days build up a sleep debt that cannot be repaid. This debt impacts a motorist's performance behind the wheel. For example, a driver that gets two fewer hours of sleep in a single day may mimic someone who has a Blood Alcohol Content (BAC) level of 0.05% (Rosekind, 2014). Experts from numerous disciplines are sounding the alarm and rightly so. Drowsy drivers have (Czeisler & Baldino, 2015):

- **Slower reaction times**
- **Impaired judgment**
- **Increased levels of risk taking**
- **More frequent blinking/eye closure**
- **Deficits in cognitive performance**
- **Memory impairment**
- **Attention failure**
- **Loss of visual awareness**

Drowsy drivers are also more easily distracted and suffer even greater performance deficits if they drink alcohol, use illegal drugs or take prescription or over-the-counter medication. The use of illegal and legal drugs and medications can also cause drowsiness. If a driver gets behind the wheel after consuming a drug that has this side-effect and is involved in a crash or stopped by a police officer, is it drowsy driving or drugged driving or both? This issue is not discussed in this report. For additional guidance on drugged-impaired driving, consult the GHSA report, *Drug Impaired Driving: A Guide for What States Can Do*.



Who is Likely to Drive Drowsy?

No one is immune from drowsy driving, but teens and young adults are particularly vulnerable. It is estimated that drivers 25 years of age and younger are involved in more than half of drowsy driving crashes annually (Wang as cited in American Academy of Pediatrics [AAP], 2014a). Driving inexperience coupled with biological changes that impact a teen and young adult's sleep-wake cycle appear to explain the increased risk. The delayed timing of the secretion of the chemical melatonin, which causes sleepiness, and an altered sleep drive prompt teens to stay awake later (Tarokh & Carskadon, 2009). At the same time, their need for at least 8.5 to 9.5 hours of sleep per night does not diminish. Add school, work and social demands along with technology to the mix, and the result is sleep-deprived teens.

The CDC analyzed data from 50,370 high school students who completed the national Youth Risk Behavior Survey and found that fewer than 30% reported sleeping eight to nine hours a night. Approximately 30% said they average seven hours of sleep a night, 22% reported getting six hours, while 10.5% of teens got just five hours. Girls were less likely than boys to get sufficient sleep – 66.4% compared to 71%. The research not only confirmed that insufficient sleep contributes to injury risk, but also results in teens being more likely to drink and drive, text while driving, ride with a driver who has consumed alcohol, and not buckle up (Wheaton et al., 2016).

The CDC analyzed data from 50,370 high school students who completed the national Youth Risk Behavior Survey and found that fewer than 30% reported sleeping eight to nine hours a night , the recommended amount for this age group.

College Students

This lack of sleep continues and even worsens as teens head off to college and are no longer under parental supervision. A study of college freshmen found that they go to sleep approximately 75 minutes later than they did as

high school seniors and pull all-nighters at least once a week (Hartmann & Prichard, 2014). The researchers noted that "students experienced a social jet lag – the difference between week and weekend sleep schedules – equivalent to flying from New York to Denver and back every weekend." The problem is acute on college campuses nationwide. More than two-thirds of college students report experiencing excessive drowsiness, more than a third fall asleep in class at least once a week and more than half (56.8%) get enough sleep to feel rested at most only three nights a week (Center for College Sleep/University of St. Thomas [CCS], 2014).

More than two-thirds of college students report experiencing excessive drowsiness and more than a third fall asleep in class at least once a week.

Stress appears to be the primary contributing factor for poor sleep among college students. Instead of engaging in relaxing activities before bed, students do homework until exhausted, check their social network or watch television. These practices actually delay the body's ability to sleep. Once students finally call it a night, they are so exhausted they cannot "shut off their brains" enough to fall asleep (Hartmann & Prichard, 2014). Two California State University professors posit that this stress-induced lack of sleep is exacerbated by a students' fear of missing out (FOMO), resulting from an attachment to their smartphones. Their survey of more than 700 college students found that FOMO had the strongest negative effect on their sleep, and that students who were more anxious about being apart from their phones used them more during the day and woke up to check them at night (Browning, 2015).

Shift & Night Workers

The problem of drowsy driving is not confined only to teens and young adults. It is estimated that more than 9.5 million people, or 15% of the workforce, work overnight or rotating shifts. People who work night shifts and/or long or irregular hours, including first responders (e.g., police, fire, EMS), doctors and nurses, and commercial motor vehicle operators, are at high risk. Night and shift work occurs in an array of industries from retail and gaming to manufacturing and hospitality.

Shift and night work cause disruptions to employees' sleep wake cycles and insufficient sleep. Research using driving simulators to evaluate the daytime performance of night shift workers after a night of work compared to driving after a night of sleep, found that 37.5% of the participants had a near-crash event. After a night of sufficient sleep, these same workers had no near-crashes. Noticeable findings of the post-night shift simulator drives included increased emergency braking and lane excursions, inability to maintain vehicle control, longer blink duration, increased slow eye movements, and a higher risk of micro-sleeps after driving for more than 30 minutes. The researchers noted that even seasoned night-shift workers were at risk for drowsy driving and had reactions similar to drivers with elevated BACs (Czeisler et al., 2015).

Tired Cops & EMS Providers

While a law enforcement official would likely not engage in a high-speed chase while intoxicated, experts point out that "they routinely get into a patrol car while similarly impaired from 24 or more hours of sustained wakefulness

or many consecutive days with fewer than five hours of sleep" (Vila, 2011). The problem is caused by work-hour practices that include shift work (typically ranging from 8 to 12 hours) coupled with overtime and moonlighting. These long periods of work impact a police officer's ability to adequately rest and recuperate.

A study of nearly 5,000 North American police officers, found that sleepiness is a common problem with 46% reporting falling asleep while driving. Even more concerning, a quarter said it happened one to two times a month. The findings also indicated that approximately 40% of the officers screened positive for sleep disorders (nearly double the rate of the general population) (Rajaratnam et al., 2011). Sleep deprivation is shown to be the cause of as much as 50% of on-the-job accidents and injuries, including motor vehicle crashes, involving law enforcement officers (Vila, 2000).

Emergency Medical Services (EMS) are required every day of the year. This increases the odds for these critical personnel to not get sufficient sleep and/or work long and unpredictable hours, often in extreme weather or at man-made disaster situations. Recent research indicates that more than half of EMS clinicians report being fatigued on the job, getting less than six hours of sleep a day, and rating their sleep as poor (NHTSA, 2016). While the industry has adopted evidence-based medical practices and protocols for treating patients, it admits that the same cannot be said for reducing fatigue (EMS/NHTSA, 2016). NHTSA, however, is working with EMS to address this issue (discussed briefly on page 34 of this report).

A study of nearly 5,000 North American police officers, found that sleepiness is a common problem with 46% reporting falling asleep while driving.

Health Care Workers

Drowsy driving also plagues the health care industry, which employs 14 million, and like law enforcement, operates 24/7. A study examining the impact of drowsy driving on nurses, who typically work shifts ranging from 8 to 13 hours (Stimpfel & Aiken, 2012), found that nearly two-thirds experienced a drowsy driving episode over a four-week period (Scott et al., 2007). A small number (3%) said they were drowsy after every shift. Not surprisingly, night shift nurses and those who got less sleep before work reported more problems with drowsy driving than their day-time counterparts.

The problem is particularly acute for medical residents who make up approximately 25% of all physicians working in U.S. hospitals (Blum et al., 2011). While long and unpredictable work hours are commonplace, there are regulations limiting the number of hours a resident may work in a week (80 hours) as well as how many hours they can work without time for sleep (16 hours). Doctors, however, are still getting behind the wheel tired. A nationwide, web-based survey of first-year residents found that each monthly overnight shift (more than 24 hours) increased their crash risk by 9.1% and the risk of a crash on the way home from work by 16.2% (Barger et al., 2005).

Commercial Motor Vehicle Operators

In 2013, 12.7% of all U.S. fatal crashes and 6.8% of all non-fatal crashes involved at least one large truck or bus (Federal Motor Carrier Safety Administration [FMCSA], 2015). It is estimated that 10% to 20% of these crashes may have involved tired drivers (The National Academy of Sciences, Engineering and Medicine, [NAS], 2016). Long work hours, irregular schedules and the economic pressures associated with moving goods and people, put commercial motor vehicle (CMV) operators at risk for not getting sufficient sleep and for developing health issues.

Three naturalistic studies conducted over the past ten years confirm that CMV operators are not getting sufficient sleep (Dinges et al., 2005; Hanowski et al., 2007; Van Dongen & Mollicone, 2014, as cited in NAS, 2016). Drivers averaged 5 to 6.2 hours of sleep per work day compared to an average of 6.5 to 9.89 hours on an off-duty day. While it could be argued that the additional sleep hours accumulated on non-work days could help reduce a driver's sleep debt, researchers noted that repeatedly cycling between five to seven days of inadequate sleep, followed by one to two days of recovery sleep has negative health and safety consequences. The Federal Motor Carrier Safety Administration (FMSCA) estimated that 13% of CMV operators drive fatigued (CVSA, 2014).

FMCSA has attempted to address the problem through Hours of Service (HOS) regulations. These rules establish the maximum number of hours in a day and a week that a CMV operator can drive, as well as rules on breaks and restarts (when a driver may resume working after taking a minimum number of consecutive hours off). However, repeated efforts to modify HOS regulations have resulted in the suspension of some provisions. Additionally, HOS rules impact CMV drivers differently depending on how they are employed and what they drive. The need to ensure that drivers are well rested and alert before getting behind the wheel remains problematic.

People With Sleep Disorders

More than 70 sleep disorders affect at least 40 million Americans, resulting in an estimated $16 billion annually in medical costs not including lost work time, motor vehicle crashes, and other factors (NIH, 2011). Individuals with untreated sleep disorders – the most prevalent being insomnia (trouble falling and staying asleep), sleep apnea (or sleep-disordered breathing), restless legs syndrome (tingling in the legs), and narcolepsy (extreme sleepiness

Surviving Baby, Helping Parents Get Some Sleep

New parents, who are often struggling to get some sleep, run the risk of driving drowsy. According to the New York State Department of Health (2007), having and maintaining a set routine for mom, dad and baby is critical. Parents should also sleep even when their baby sleeps. Taking a 20-minute nap, in a darkened, quiet room can be just what a groggy parent needs to feel refreshed. And asking a family member or close friend to watch the baby, when one or both parents need to sleep, is not admitting defeat.

even after a good night's sleep) – and new parents also struggle with getting a good night's sleep (NIH, 2011). While technically not a sleep disorder, few would argue that parenthood can negatively impact sleep (see the pull out box, *Surviving Baby*)! In fact, 42% of people with children under age 18 report getting inadequate sleep (Holohan, 2014).

It is estimated that 13% of men and 6% of women between 30 and 70 years of age have moderate to severe sleep apnea. The problem is more prevalent in overweight, older men, which may explain why it impacts more CMV drivers (who tend to have a more sedentary lifestyle) than the general driving population (Colvin & Collop, 2016). While snoring is a common sign of sleep apnea, not everyone who snores has the condition. But a study of older adults who snored six to seven nights a week, found that they were more likely to report being extremely sleepy during the day than those who did not snore. In fact, snorers are more likely to be involved in car crashes then people who do not snore (NIH, 2011).

Many people who suffer from sleep disorders are undiagnosed and untreated, which means they may not recognize they are having problems with alertness or drowsiness when driving (Arbus et al., 1991; Hansotia, 1997, as cited in NHTSA, 1998). Federal regulations require CMV drivers to meet certain criteria regarding medical fitness to drive and to certify if they suffer from any sleep disorders. While the medical examination form asks about "sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring," it does not specifically include sleep apnea (U.S. Federal Register, 2000).

Meanwhile, efforts to ensure that the general public recognizes they may be suffering from a sleep-related problem that could impact the safe operation of a motor vehicle are extremely limited. Often, the driver has to fall asleep at the wheel, before he or she is aware of the need to seek medical care. Plus, deficiencies in training hamper the medical diagnosis of sleep-related disorders. A National Sleep Foundation (NSF) survey found that less than 10% of primary care physicians ask their patients about sleep habits or patterns. This is likely attributed to the fact that the average medical school curriculum devotes approximately 2.1 hours to sleep and sleep disorders, while medical textbooks make up only about 2% of the content (Miller, 2008).

Many people who suffer from sleep disorders are undiagnosed and untreated, which means they may not recognize they are having problems with alertness or drowsiness when driving.

Reframing the Issue

Clearly there is a need to reframe the importance of sleep and its impact on our health and safety. While some may think sleep is overrated, it is a life-sustaining activity that is just as important as eating right and exercising. When we sleep, our brains go to work forming the pathways necessary for learning and creating new memories and insights. Our bodies also produce hormones that help us grow, produce muscle mass, fight infections, and repair cells. Skimping on sleep not only makes us less sharp and able to react quickly – critical for safe driving – it also affects our mental health and increases the risk of high blood pressure, heart disease, obesity, and many other medical conditions (NIH, 2011).

Americans say they want more sleep. A TODAY *Snooze or Lose Sleep Survey* found that 72% of us view sleep as one of the great pleasures of life (Holohan, 2014). But our desire for sleep is not translated into action:

- **33% of 18- to 34-year-olds and 19% of 35- to 54-year-olds believe that to get ahead in their careers, they must survive on less sleep (the rate falls to just 6% for professionals 55 and older).**
- **40% of 18- to 34-year-olds, 33% of 35- to 54-year-olds and 11% of people 55 and older believe that if they want to work and care for their families, they must do it on less sleep.**
- **64% of 18- to 34-year-olds, 49% of 35- to 54-year-olds and 35% of those 55 and older agree that being able to survive on less sleep would be an advantage.**

Skimping on sleep not only makes us less sharp and able to react quickly – critical for safe driving – it also affects our mental health and increases the risk of high blood pressure, heart disease, obesity, and many other medical conditions.

Health and safety experts agree that the key to making sleep a priority is to not only recognize why it is so important, but also to make lifestyle changes that ensure that we get adequate and restorative rest. A national movement to do just that is underway.

The American Thoracic Society (ATS), for example, released a policy statement in 2015 calling on clinicians and the public to take steps to get enough sleep. Recommendations include recognizing sleep as a quality of life issue; identifying optimal sleep duration for children and adults; and providing education about how to recognize the symptoms of drowsy driving, good sleep hygiene, the impact of working hours and shift work on sleep, and the diagnosis and treatment of sleep disorders (Hughes, 2015).

The Huffington Post (HuffPost) launched the *#TakeABreaktoStayAwake* campaign on social media in April and has devoted a section of its website to sleep. Calling drowsy driving an epidemic, the HuffPost via change.org calls on the public to get educated about the issue, take a pledge to not drive drowsy, and use the sample tweets and Facebook posts to encourage others to join the movement. HuffPost also conducted sleep fairs on 16 college campuses in the spring of 2016 and helped 35 other institutions organize sleep-related events led by students and staff through its *Sleep Revolution College Tour.* Students learned about the importance of sleep and how to get it, were encouraged to get seven to eight hours of sleep and challenge two friends to do the same, and to blog about their personal sleep stories and what they've learned. Students were also educated about the dangers of getting behind the wheel when their mental faculties are impacted by lack of sleep or any other impairment and encouraged to take advantage of free rides (between 10 p.m. and 2 a.m.) provided through a partnership with Toyota and Uber.

Businesses are also getting on board as they recognize the impact sleepy employees have on the bottom line – $63 billion a year in lost productivity, say researchers at Harvard Medical School (Che, 2016). Nap rooms are commonplace at socially-minded companies like Google, Zappos, Ben & Jerry's, Nike, and The Huffington Post (and on college campuses including Wake Forest, James Madison, University of Michigan and Savannah College of Art and Design). But even financial institutions, long recognized for their grueling 100-hour workweeks, recognize the need for a change. Calling the initiative "pencils down," JP Morgan instructed its investment bankers to stop working on weekends (unless they are working on an active deal). Goldman Sachs instituted a similar policy, while Bank of America provides junior bankers a monthly "protected" weekend where they are not expected to work (Peck, 2016).

One company, Aetna, is even paying its employees to get more sleep. Workers who can prove they get 20, seven-hour nights of sleep or more in a row, earn $25 a night, up to $500 a year. (Aetna uses a variety of methods including Fitbit devices to help employees track their sleep.) Working with Duke University, the health care giant studied the effectiveness of its wellness program (Get Active Aetna), which includes information about better sleep, and found a 69-minute a month improvement in worker productivity (Belvedere, 2016).

Aetna's experience lends credence to the findings of a 2015 Sleep in America® poll, which asked people about their sleep motivation and quality. Respondents who said they were *very or extremely motivated to get enough sleep* reported sleeping an average of 36 more minutes per night across the week compared to those who were *not that motivated or not motivated at all* (7.3 versus 6.7 hours). Sleep quality was also higher among more motivated sleepers – 62% rated their sleep quality as *good or very good* compared with just 41% of their less or not at all motivated counterparts. Motivated sleepers also reported *less difficulty sleeping* than those who were not that or at all motivated to get more sleep (29% versus 39%) (NSF, 2015a).

Drowsy Driving is Impaired Driving

In addition to making a good night's sleep a priority, it is also time to rethink how we view drowsy driving. It is a public health crisis that, just like other unsafe and risky behaviors, puts all roadway users at risk. That is the position of the NHTSA Administrator, an internationally recognized sleep expert, who has expanded the agency's definition of impaired driving to include not only drunk, drugged and distracted, but drowsy. The latter, he said, "is the universal one. Everyone needs to be awake and alert behind the wheel. While not everyone drives after consuming alcohol or taking drugs, or drives distracted, we all have the potential to be drowsy. And if we do get behind the wheel without enough sleep and engage in any of these other unsafe behaviors, it makes them really worse" (Rosekind personal communication, 2016).

NHTSA is, however, doing more than adding a *fourth D* to the discussion. In March, the agency unveiled its first-ever Drowsy Driving Research and Program Plan to enhance the science and program initiatives. The multi-year blueprint addresses six broad focus areas: measurement and problem identification, public awareness and education, policy development, high-risk populations, vehicle technology, and infrastructure. Ten projects are outlined under the focus areas and all are underway including development of drowsy driving program guidelines for State Highway Safety Offices (SHSOs), reporting protocols for drowsy driving, law enforcement training, messaging and public education materials, and EMS fatigue management guidelines (NHTSA, 2016).

The Administrator also pointed to the need for real world deployment of the drowsy driving message. "Asking the

Students Sound Off About Sleep… or the Lack Off

The Huffington Post invited college students to blog about sleep using the hastag #SleepRevolution. A Belmont University student wrote:

I know students who have given up on getting quality sleep because they have come to believe that success is somehow equivalent to feeling tired and stressed most of the time. Read the blog

Another wrote:

Georgetown students are so hell-bent on getting good grades and being over involved…that getting a good amount of sleep is often…far back on their priority list. Read the blog

But this University of Chicago student pointed out that there is a way to maintain a healthy school/life/sleep balance:

Taking breaks and letting our minds rest could be an effective strategy for achieving our goals in the long run, because stress or lack of sleep can hinder productivity. Read the blog

public to think about the importance of sleep and its impact on safe driving when we move the clocks forward or back, isn't going to get the job done [see pull out box for more information]. Working with the states, public health, law enforcement, elected officials, advocates, and many other partners, NHTSA can leverage its experience in doing national campaigns to move drowsy driving from a one-shot deal to a year-round initiative" (Rosekind personal communication, 2016).

Drowsy Driving as an Emphasis Area

Making drowsy driving a year-round priority will also require including it as an emphasis area in state Strategic Highway Safety Plans (SHSP) and Highway Safety Plans (HSP). That presents a challenge since state data may not indicate that it is a significant traffic safety problem, particularly in comparison to other issues. However, the case can and should be made for including drowsy driving data in the impaired driving section of a state's SHSP and HSP, noting what is being done to address it, as well as what efforts are being undertaken to fully determine the extent of the problem, with a particular focus on data collection.

The FAST Act allows states to use Section 402 and unrestricted Section 405 grant funds to address drowsy driving. When it comes to the latter, federal regulations allow high performing states to use funds for any project or activity eligible for funding under section 402. That percentage varies by program area – 100% for high belt use states (90% or higher), up to 50% for states with low impaired driving fatality rates (0.30 or lower), up to 75% for states that have conformed their distracted driving data to the most recent Model Minimum Uniform Crash Criteria (under the Comprehensive Distracted Driving grant) or up to 15% in Fiscal Year (FY) 2017 and up to 25% in FY 2018 (under the Special Distracted Driving grant).

Making Sleep a Year-Round Priority

Moving sleep from a weeklong to a year-round priority will take a collaborative effort. Currently, sleep and its impact on our health and safety are the focus of two weeklong observances led by the National Sleep Foundation. The first, Sleep Awareness Week, is observed during the first full-week of March to encourage us to prioritize sleep and adjust our routines in advance of daylight savings time. The second, Drowsy Driving Prevention Week (DDPW), the first full week of November, calls attention to healthy sleep and the dangers of getting behind the wheel when not well rested. Teen drivers were the focus of the 2015 DDPW campaign, which included downloadable educational and press materials to help get the word out.

The Network of Employers for Traffic Safety (NETS) also made sleep a focal point of Drive Safely Work Week (DSWW) in 2015. Conducted annually since 1996, DSWW is promoted through a campaign toolkit that includes undated materials that can be used throughout the year. A Daily Planning Checklist reminds employees to start the day right by getting enough sleep, eating breakfast and knowing where you're going and what you're doing.

Drowsy Driving Countermeasures

There is no single countermeasure that can prevent drowsy driving; such a magic bullet simply does not exist. A multi-faceted approach – one that leverages all of the traffic safety E's (education, enforcement, engineering and emergency management service) and incorporates an array of strategies and tactics – is the best approach. This section of the report explores what is being done at the national, state and local level to address drowsy driving. In addition to identifying current and best practices, it also points out limitations and/or deficiencies.

Data Collection

Data collection should be the first focus of any SHSO, agency or organizational drowsy driving plan.

Having good data is critical, but *good drowsy driving data* is not always readily available. Since crash reports are the primary source of these data, the police officer completing the form must rely on information provided by the driver(s) and/or passenger(s) as well as circumstantial evidence to determine if drowsiness was a factor. As noted earlier in this report, this data collection method is impacted by the officer's ability to recognize the signs of drowsy driving and the driver's ability and/or willingness to identify drowsiness as the reason for the crash.

According to a 2015 NSF survey of the states, only Missouri does not capture drowsy driving on its crash form (NSF, 2015b). The nomenclature states use to capture drowsy driving as a contributing factor on crash forms typically includes fatigue, fell asleep or some variant of that. This factor is

Since crash reports are the primary source of [drowsy driving] data, the police officer completing the form must rely on information provided by the driver(s) and/or passenger(s) as well as circumstantial evidence to determine if drowsiness was a factor.

often coupled with driver inattention, distraction and/or the presence of drugs or alcohol. Only four states – Idaho, Illinois, Oklahoma, and Oregon – specifically reference *drowsy* on their crash forms. The fourth edition of the Model Minimum Uniform Crash Criteria (MMUCC) uses asleep or fatigued, located under the Person Data Elements (P17 – Condition at Time of the Crash) to identify a drowsy driver.

NHTSA's *Drowsy Driving Plan* calls for exploring the potential of using a method similar to the one used in alcohol data imputation to better quantify the extent of drowsy driving (NHTSA, 2016). However, states should be encouraged to include a drowsy driving-related factor on their crash reports. The definition of drowsy driving may be revised in the next edition of MMUCC so that it aligns with what is in FARS. Additionally, making sleep or fatigued a stand-alone attribute is strongly recommended as a way to encourage states to not only collect the data, but collect it in a consistent manner. That will require tools and training to help law enforcement better identify drowsy driving as well as properly record it on crash reports.

Drowsy Driving Laws

Only two states – New Jersey and Arkansas – have enacted legislation that expressly addresses motorists who drive drowsy and subsequently injure or kill someone. New Jersey's statute, known as Maggie's Law, took effect in 2003. It is named for a 20-year-old college student who was killed by a driver who had not slept in 30 hours and smoked crack cocaine. The crash led to two trials resulting in the driver receiving a $200 fine and a suspended jail sentence since driver fatigue could not be considered as a factor by either jury. The statute deems driving "while knowingly fatigued as recklessness" and defines fatigued as "being without sleep for a period in excess of 24 consecutive hours" (New Jersey Legislature, 2002).

Carol McDonnell lobbied for passage of New Jersey's drowsy driving law, named in honor of her daughter, Maggie, a 20-year-old college student who was killed in 1997 by a driver who had not slept in 30 hours and smoked crack cocaine.

Arkansas' law, like New Jersey's, defines fatigue in the same way, but also adds "or in the state of being asleep" (Arkansas General Assembly, 2013). In both states, law enforcement has had limited success convicting drowsy drivers under these statues. While the number of drowsy driving related convictions in New Jersey is not known (statistics are maintained by statute, not the specific offense), Arkansas has had three convictions since its law took effect in 2013. "The law requires the admission that you were up for 24 hours," said the Highway Patrol Division Commander of the Arkansas State Police (ASP). "That's the challenge; drivers don't want to admit to this because they're afraid it will be treated as impairment. If the crash resulted in a fatality, the driver is even less likely to say he fell asleep."

New Jersey's law is also not without its challenges. "The investigative aspect of these cases is not a cake walk," said a detective with the Bergen County Prosecutor's Office. "We have to exhaust all other factors before we can say lack of sleep is the only reasonable

explanation. But even when we can collect and present evidence that points to drowsy driving as the reason for the crash, getting a jury to convict is problematic. They just don't see drowsy driving as the reckless operation of a vehicle. It's the issue we had with DWI years ago; we need the public to recognize that motorists should know better than to get behind the wheel if they're too tired to drive. "

The 2015 fatal crash on the New Jersey Turnpike that critically injured comedian, Tracy Morgan, and killed his friend and colleague, James McNair, has once again put state laws and the issue of drowsy driving in the national spotlight. Both state law enforcement officials recognize the need for a statute addressing the problem, but also pointed out that their respective laws are far from perfect. For example, the Arkansas Commander would like to see the 24 hour threshold lowered to 16 hours. "A driver's ability to safely operate a vehicle is impacted well before what is implied in the statute," he affirmed.

The New Jersey detective, meanwhile, believes that his state's law should be changed so a jury is impelled to indict a sleep-deprived driver. "As [NJ's] law reads now, it says being up without sleep for 24 hours '*may* give rise to an inference that the defendant was driving recklessly.' The law should be changed from *may* to *shall*," he explained.

While sleep advocates are encouraging other states to follow Arkansas and New Jersey's lead, the effectiveness of these laws is still up for debate. Some argue that most states already have laws on the books to charge drivers who fall asleep at the wheel, crash and kill someone. While GHSA has not adopted an official position on states enacting drowsy driving laws, the association notes that any law that addresses impairment – including drowsy driving – must be enforceable (GHSA, 2015). NHTSA will be working with both states to determine to what extent the laws are enforced as well as their awareness among the general public (NHTSA, 2016).

In the meantime, a review of state legislative action going back to 2009, confirms that efforts to pass legislation similar to what is in place in Arkansas and New Jersey have not been successful (the most recent attempts taking place in Alabama and New York) (National Conference of State Legislatures, 2015). Instead, state legislatures such as California, Florida, and Texas have adopted resolutions that designate *Drowsy Driver Awareness* and/or *Prevention Weeks*. One such resolution is currently pending in the Alabama Legislature. NSF has developed a Drowsy Driving Advocacy Kit to help jumpstart state advocacy efforts. It includes an action plan, fact sheet, overview of current state policies, sample correspondence, and links to research and reports.

While GHSA has not adopted an official position on states enacting drowsy driving laws ... any law that addresses impairment – including drowsy driving – must be enforceable.

Teen Driver Policies

States seeking to reduce the incidence of teen-related drowsy driving crashes may want to consider measures that focus specifically on when they are on the road. Two policies – nighttime driving restrictions and later school start times – are found to positively impact teen crash rates.

Nighttime Driving Restrictions

Currently, the Graduated Driver License (GDL) laws in 49 states and D.C. place limits on when teens can drive after dark, ranging from sundown to sunset to the less restrictive 1 to 4 a.m. The nighttime driving restriction is shown to reduce teen crashes during the restricted hours between 40% and 60% (McCartt et al., 2010). This is important since 39% of fatal crashes involving 16- and 17-year-old drivers occur at night (Williams & Preusser as cited in Rajaratnam et al., 2015).

The nighttime driving restriction is shown to reduce teen crashes during the restricted hours between 40% and 60%. This is important since 39% of fatal crashes involving 16- and 17-year-old drivers occur at night.

Research examining the impact of Massachusetts' midnight to 5 a.m. nighttime driving restriction for junior operators (teens under 18 years of age) found that the GDL provision had even more impact when it was accompanied by strict penalties. The change was one of a series made to Massachusetts' GDL law, prompted by a high-profile fatal crash involving a U.S. Army reservist and a drowsy teenage driver. Teens who violate the restriction are not only assessed a monetary fine ($35 for the first offense; $75-100 for any subsequent offense), but also subject to a 60-day, 180-day or one-year license suspension for the first, second and third offenses, respectively. They are also required to attend driving retraining for second and subsequent offenses.

Researchers evaluated the impact of this change on police-reported crashes for the year before and five years after its enactment for 16- and 17-year-old drivers and two comparison groups (18- and 19-year-olds and drivers 20 and older). The rate of overall and night crashes decreased 19.1% and 28.8%, respectively for drivers 16 and 17 years of age, relative to drivers 20 and older. The rate of crashes involving a fatal or incapacitating injury fell by 39.8% for the younger drivers, relative to the older drivers. The safety gain is "likely driven by mitigating risks posed by sleepiness-related impairment, risk-taking behaviors, and driving alone or driving with young passengers" (Rajaratnam et al., 2015).

It is important to point out that in addition to increasing the nighttime driving penalties, the amendments to the state's GDL law also included: restrictions on transporting passengers younger than 18 years of age during the first six months of licensure; increased penalties for speeding, drag racing and negligent or reckless driving; prescribed requirements for driver education courses and providers, including development of a driver education curriculum that includes fatigue; supervised driving; and the creation of a public awareness campaign addressing the major causes of teen crashes including sleep deprivation. While the researchers noted that they "were unable to determine which provision of the law contributed most to the decline" in teen crash rates, the "relatively larger decline in crashes during the night hours… indicate that increased penalties for violating the restriction on unsupervised night driving had an important impact" (Rajaratnam et al., 2015).

The restrictions associated with GDL laws apply only to teens younger than 18 in nearly every state (New Jersey is the rare exception). This prompted the researchers who examined Massachusetts' teen driving law to stress the importance of developing interventions to educate older teens about the risk of drowsy driving. Their analysis found that 18- and 19-year-olds had the highest night crash rate of all age groups (Rajaratnam, 2015). Earlier research indicates that 55% of fall-asleep crashes involve drivers 25 years of age and younger, with a peak age of 20 (Pack et al., as cited in Rajaratnam, 2015).

Later School Start Times

The idea of starting school later to allow teens to get more sleep is not new. In Loudon County, VA, the high school starting bell has been 9 a.m. since 1954 (middle school begins at 8:30 a.m. and elementary schools at 7:50 a.m.). Some school districts in Dallas and Austin, TX, have had 9 a.m. or later high school start times since the early 1990s (The Children's National Medical Center [CNMC], 2014). But the issue has gained significant momentum since 2014, when the American Academy of Pediatrics (AAP) issued a policy statement calling on schools to shift to an 8:30 a.m. or later start time for middle and high school students.

Why is a shift important? "Chronic sleep loss in children and adolescents is one of the most common – and easily fixable – public health issues in the U.S. today," said the lead author of the AAP's later school start time policy statement (AAP, 2014b). "The research is clear that adolescents who get enough sleep have a reduced risk of being overweight or suffering depression, are less likely to be involved in automobile accidents, and have better grades, higher standardized test scores and an overall better quality of life."

The research is clear that adolescents who get enough sleep have a reduced risk of being overweight or suffering depression, are less likely to be involved in automobile accidents, and have better grades, higher standardized test scores and an overall better quality of life.

A precise tally of schools that adhere to the AAP recommendation is not currently known. Some estimates put the number at 1,000 schools in 70 school districts (CNMC, 2014). A CDC review of the start times at nearly 40,000 U.S. public middle, high school and combined schools (with an estimated total enrollment of 26.3 million students) during the 2011-2012 school year, found that fewer than one in five began at the AAP recommended time. The analysis revealed that (Wheaton et al., 2015):

- **75 to 100% of the schools in 42 states started before 8:30 a.m. (average start time, 8:03 a.m.)**
- **17.7% of public schools started at 8:30 a.m. or later (lowest for high schools, 14.4%; highest for combined schools, 23.4%)**
- **Schools starting at 8:30 a.m. or later varied by state, ranging from 0% in Hawaii, Mississippi and Wyoming to 76.8% and 78.5% in Alaska and North Dakota, respectively (both states also had the latest average start times)**
- **Louisiana has the earliest average school start time (7:40 a.m.) and the largest percentage of schools starting before 7:30 a.m. (29.9%).**

Public health practitioners are troubled by the findings, particularly since the proportion of students who get sufficient sleep has been stuck at 31% since 2007, the first year the national Youth Risk Behavior Survey included a question about sleep (Basch et al., as cited in Wheaton et al., 2015).

There is some good news. Ever since the Edina (Minnesota) School District became the first in the nation to delay high school start times based on sleep research, school districts have been jumping on board, albeit slowly. From New York's Glens Falls High School and the Evergreen Public Schools in Kentucky to the Columbia (Missouri) and Seattle (Washington) School Districts, students are starting school later, and that appears to be paying off. Studies indicate that 57% to 66% of teens attending schools that start at 8:35 a.m. report getting eight or more hours of sleep on school nights as compared to teens who begin at 7:30 a.m. (34%) (Wahlstrom, 2016; Danner & Phillips, 2008). More sleep has resulted in improvements in academic achievement and attendance, reductions in tardiness, and even gains in athletic performance (Wahlstrom, 2013; Wahlstrom personnel communication, 2016).

Later school start times have also been shown to reduce teen driver crashes. A three-year study of 9-12th grade students attending eight high schools in Minnesota, Colorado and Wyoming, with start times ranging from 8 a.m. to 8:55 a.m., found that crashes involving 16- to 18-year-old drivers fell by 13%. In one of the schools (Teton County School District, Jackson Hole, WY), the crash rate fell 70% (from 23 to seven) the year after the start time changed from 7:35 a.m. to 8:55 a.m. The researchers pointed out that Jackson Hole High School is the only major high school in the county, allowing for greater confidence that the drop in crashes was not influenced by changes at other high schools. The significant drop might be explained by the fact that over 66% of Jackson Hole's students reported getting more than eight hours of sleep each school night (Wahlstrom et al., 2014; Wahlstrom, 2016).

Later school start times have been shown to reduce teen driver crashes.

While there is substantial evidence that later school start times prompt educational, health and safety gains, making the change can be fraught with roadblocks from concerns about changing bus schedules and difficulty scheduling after-school activities (especially sports), to parent work schedules and day care for younger students. However, proponents of later school start times say that these and other common barriers can be overcome. School districts that have the least contentious debates are the ones where the superintendent and school board are aligned on most issues, all stakeholders are consulted and kept informed, and all available facts are gathered and used to frame the discussion (Wahlstrom, 2015). The latter is vital, said both researchers and school administrators, who stress the need to keep the discussion of why a school should do this focused on what is best for students' health and well-being.

A Legislative Push to Start Schools Later

Elected officials at both the federal and state level have joined the call for later school start times – or at least are calling for further study. Since 1998, U.S. House of Representatives member Zoe Lofgren (D-CA) has been

urging Congress to adopt a resolution calling on schools to consider a later start time (8:30 or 9 a.m.) or pass legislation (The Zzz's to A's Act), directing the Department of Education to study the effects of school start times on students' academic performance.

At the state level, legislators have sponsored bills calling for the establishment of a task force to study the issue; the most recent were signed into law in Maryland (HB883, 2014) and New Jersey (S2484, 2015). While the former's task force is still at work, Maryland's conducted their analysis and subsequently issued a report in late 2014 that recommended the State Board of Education advise local school systems about the benefits of later school start times and encourage them to conduct feasibility studies (Maryland Department of Health and Mental Hygiene, 2014). However, earlier this year the Maryland Legislature passed HB39, which establishes an Orange Ribbon for Healthy School Hours certification program to incentivize school districts to adopt later start times for all students. The bill states that (Maryland Legislature, 2016):

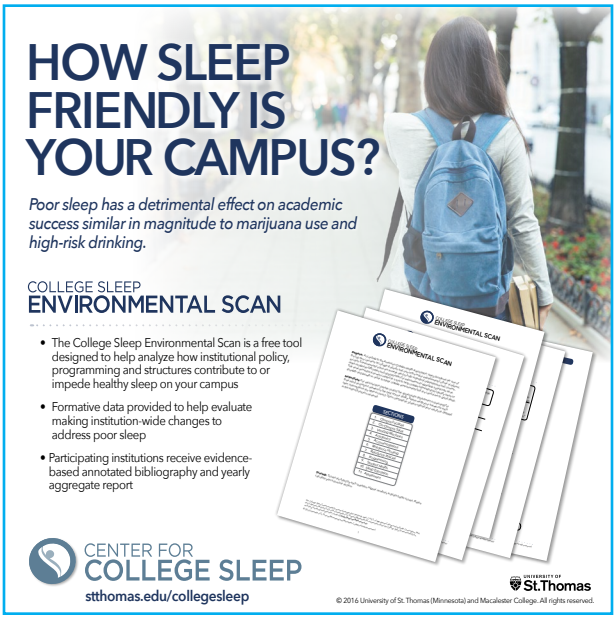
> ***…local feasibility studies [as recommended in the Task Force report] involve unnecessary and wasteful expenditure of time, money and human resources and only replicate an already extensive body of evidence about the implementation of school hours for the sake of student's health, safety and academic success.***

This begs the question, is further study needed? As HB39 points out, "a strong body of scientific evidence that sleep is critical to health and academic achievement" is readily available (Maryland Legislature, 2016).

A strong body of scientific evidence that sleep is critical to health and academic achievement is readily available.

Tools to Help Colleges & Universities

Poor sleep on college campuses is rampant and purported to have negative effects similar to marijuana use and high-risk drinking (Center for College Sleep/ St. Thomas University and Macalester College [CCS/ STU/MC], 2016a). Despite impacting classroom and athletic performance as well as mental and physical health, only 15% of students with sleep problems seek help from university health services (CCS, 2014). That prompted professors at Macalester College and St. Thomas University to develop the first College Sleep Environmental Scan, which is designed to help colleges and universities address how institutional policy, programming and structures help or hinder healthy sleep.



The tool is free and available via online sign-up (starting summer 2016). It takes approximately two to four hours for a college/university official to answer all of the questions and enter the information into an online form. This information is then reviewed and within two weeks the college or university receives an annotated bibliography outlining best practices for college sleep environments and policies. A reference group executive summary providing national benchmark comparisons is provided annually in August to participating institutions (no college or university is identified; individual results are confidential). Twelve months after completing the original scan, each campus receives a brief follow-up survey to assess progress made to date.

As of January 2016, more than 50 colleges and universities have taken the scan. Institutions have reported changes in health centers, dining services, residential housing, and academic curriculum to improve student sleep (CSS/STU/MCC, 2016b).

In addition to the scan, CSS also developed an assessment tool for students that screens for physiological, psychological and behavioral impediments to sleep. The College Sleep Questionnaire© (CSQ), is a 15-minute web-based application that gives a student instant feedback about nine measures of sleep health, compares his or her sleep to national norms, and provides tips to improve sleep. Reports can be shared with clinicians, health educators or used for pre- and post-assessments. It is also customizable – a student can be directed to an on-campus resource to assist with physical and mental health and academic issues. Institutions can also use the aggregate data to develop targeted health and wellness programs (see *Get More Zzz's* pull out box for an example).

Driver Education & Licensing Requirements

States have the opportunity to adopt driver education and licensing policies that not only alert novice drivers about the dangers of drowsy driving, but also require that applicants for a driver's license indicate if they have a medical condition, such as a sleep disorder, that could impact their ability to safely operate a motor vehicle.

Educating Novice Drivers

NSF's 2015 *State of the States Drowsy Driving* summary indicates that only 11 states require that driver education include drowsy driving information. The specifics of each

Get More Zzz's to Get More A's

To promote the importance of sleep and meaningful behavior change, The Wellness Center at Minnesota-based St. Thomas University (2015) conducted a *Get More Zzz's to Get More A's Sleep Challenge*. Students received advice and suggestions for getting a good night sleep through one-on-one chats along with a sleep mask, chamomile tea and an app to track their sleep via their smartphones. Students who tracked their sleep for seven consecutive days over a 21-day period, received three raffle tickets to win one of 10 gift cards. An additional ticket was awarded to students who attended one of two challenge breakfasts, where they could check in on their progress and eat a healthy meal before class.

Prior to the challenge, students were primarily concerned with the amount and quality of their sleep and their lack of consistency in waking up and going to bed at the same time. 88% reported a change in their concerns after completing the challenge. Noticeable improvements included an increase in sleep per night (an average of 0.3 hours), an improvement in sleep quality, and a decrease in the amount of time it took students to fall asleep. Nearly half of the students said they were likely to continue using the sleep app.

state's requirement, in particular the extent to which drowsy driving must be covered, is unknown because many states do not mandate the use of a specific curriculum. One exception is Massachusetts, which requires all public and private high schools and commercial driving schools to use a standard driver education curriculum developed by the State's Registry of Motor Vehicles (RMV). The entire curriculum consists of 15, two-hour modules taught over a 30-hour timeframe. Fatigue is addressed in Module 11, the *Mental and Physical Effects on Driving*, and requires a discussion of how fatigue affects driving ability and drowsiness causes crashes (Massachusetts Department of Transportation, 2014).

A free, downloadable driver education curriculum, developed by the American Driver and Traffic Safety Education Association (ADTSEA) in collaboration with AAA, includes a unit on the effects of fatigue and emotions on driving (the former, however, is not covered in great detail). ADTSEA Curriculum 3.0 addresses the causes and effects of fatigue through discussion, a video, and fact and worksheets. The curriculum complies with the Novice Teen Driver Education and Training Standards (ADTSEA, 2011).

Recognizing that the number of states requiring novice drivers to complete formal driver education has been on the decline, ensuring that teens receive information about drowsy driving through other means (e.g., online providers, parent-taught programs, simulator training, hazard perception and advanced driving skills) is essential.

Driver Manuals & Tests

Currently, 47 states and D.C. address drowsy driving in their driver manual (NSF, 2015b). It is unknown how many licensing exams include a question on the subject. To encourage all states to include drowsy driving in driver licensing and testing materials, the American Academy of Sleep Medicine (AASM) developed template drowsy driving language for state driver manuals, curriculum requirements and exam questions.

The sample manual language discusses the dangers and signs of drowsy driving, how to prevent it (including what does not work) and what to do if you observe a drowsy driver. The curriculum requirements call for students to identify the signs and understand the consequences of drowsy driving, recognize that they are a high-risk group, and learn how to prevent it. Two multiple-choice sample test questions are also provided (see the *Test Your Knowledge* pull out box for an example) along with information about three narrated PowerPoint presentations entitled *Sleep, Alertness and Fatigue* that are targeted to passenger vehicle drivers, truck drivers and medical residents. The first two are available on Vimeo and YouTube, while the third is available for a fee on the AASM website (AAMS, 2015a).

Every state Division of Motor Vehicles or Secretary of State's office received the template language in November 2015 and again in February 2016. According to an AASM official, to date nine states have indicated they will use or are interested in the material (AK, CA, CO, IL, IN, NE, NY, SC, VA).

Test Your Knowledge

If you are driving and feel drowsy, which of the following should you do to reduce the risk of a crash? *(Choose the best single answer.)*

A. Turn on the car radio

B. Slow down so you can react better

C. Pull over to a safe place as soon as possible and take a short nap

C is the correct answer.

License Limitations Due to Sleep Disorders

All states but one impose licensing limits on motorists with specific medical conditions, but only 12 states include sleep disorders among these conditions, with eight specifically identifying sleep apnea, narcolepsy and/or cataplexy (sudden loss of muscle tone triggered by an intense emotional experience). In addition, eight states require doctors to report medical conditions to the licensing agency (NSF, 2015b).

SHSOs and public health and traffic safety advocates and practitioners are encouraged to check their respective state licensing policies and practices to determine if motorists who are involved in drowsy driving crashes are identified, evaluated and monitored. As previously noted in this report, federal regulations require CMV drivers to meet certain criteria regarding medical fitness to drive and to certify if they suffer from any sleep disorders. However, that is not the case for non-commercial driver license holders. At the same time, while the medical examination form for CMV drivers asks about "sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring," it does not specifically include sleep apnea (U.S. Federal Register, 2000), a troubling omission.

Workplace Policies

A tired employee is a less productive, healthy and safe employee as well as a drain on the bottom line. Fatigue is estimated to cost U.S. employers $136 billion annually in health-related lost productivity, according to environmental health and safety publication, ehstoday.com (Hersmann, 2016). On-the-job roadway collisions cost employers $24,000 per crash, $45,000 per million vehicle miles traveled and $68,000 per injury (Network of Employers for Traffic Safety [NETS], 2016).

A tired employee is a less productive, healthy and safe employee as well as a drain on the bottom line. Fatigue is estimated to cost U.S. employers $136 billion annually in health-related lost productivity...

NETS suggests that one of the best ways to reduce these losses is through mandatory policies (i.e., seat belt, alcohol/drug use) that are supported by leadership and reinforced through education and outreach targeted to both employees and their families. The organization has developed a *Comprehensive Guide to Road Safety*™ that calls on organizations to adopt policies that prohibit employees and authorized drivers from operating a vehicle in a "state of fatigue or while using prescription or over-the-counter medication that may adversely impact their ability to safety operate [a] vehicle" (NETS, 2014). The document details the signs of fatigue, strategies for managing it (including *Travel & Its Impact on Sleep*, see the pull out box), and the impact of medical conditions, medication, stress, and certain food and beverages. Journey management, a system widely used by energy, logistics and transportation companies to help employees get from one location to another safely, is also discussed. To encourage other sectors to leverage the concept, it was highlighted in NETS' 2015 Drive Safety Work Week materials.

Companies can also help prioritize sleep by ensuring that employees use all of their vacation days (as many as 40% say they do not) and restricting email servers from sending work emails after a certain time of day or over the weekend. This pressure to stay connected when not in the office is costing employees precious sleep as they feel obligated to be available 24/7 (Che, 2016).

SHSOs and partners may want to survey local employers to determine if they have drowsy driving and/or fatigue-related policies in place and identify best practices. This information can be used to develop and/or expand SHSO outreach efforts to businesses.

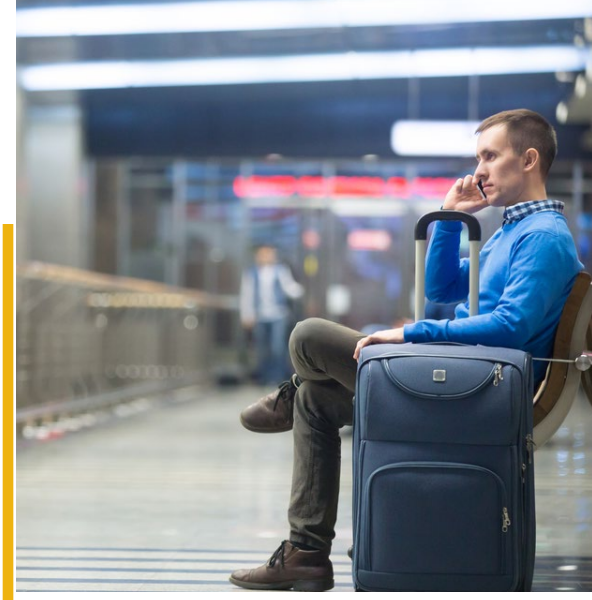
Key Employer Groups – Truckers, Docs and Cops

Every organization should be encouraged to adopt work-place policies to ensure that employees and their families recognize the importance of sleep and its impact on their safety both on and off the road. As discussed earlier in this report (see page 13), truck drivers, health care professionals, and law enforcement officials are at high-risk for drowsy driving. Do these sectors have policies to address the problem? Yes and no.

Commercial Motor Vehicle Policies

Commercial Motor Vehicle operators must comply with federally-mandated Hours of Services (HOS) regulations as explained on page 16 of this report. But concerns remain about whether these regulations are effective in ensuring that truck and bus drivers do not get behind the wheel when they are too tired to drive. It is important for SHSOs and their partners to know that this is an industry-wide concern and that some companies are instituting fatigue risk management systems (FRMS). An FRMS is a scientifically based, data-driven addition or alternative to HOS rules which allows for the flexible management of employee fatigue based on the level of risk and the nature of the work. It typically includes a fatigue management policy, ongoing risk assessment and reporting, incident investigation, training and education, sleep disorder management, and continuous improvement through internal and external auditing (Lerman et al., 2012).

Wisconsin-based Schneider National, Inc., was recognized by the National Safety Council for its "pioneering approach to fatigue management" (Schneider, 2016). One of the nation's largest trucking companies, Schneider operates a fleet of approximately 14,500 company drivers and owner-operators who log nearly 8.2 million miles a day. As part of its culture of *Safety First and Always*, all new drivers must complete classroom and computer-based training that addresses proper rest, sleep disorders and fatigue. They also undergo sleep disorder screening and if diagnosed with sleep apnea receive C-PAP (continuous positive airwave pressure) treatment, which is unique in the industry.



Travel & Its Impact on Sleep

Travel can take its toll and put employees at risk for driving drowsy. NETS (2014) recommends setting policies or, at minimum, providing guidance for a safe ride home such as:

If you cannot reach your destination within 16 hours of the time you got up, arrange for someone to drive you, take a cab or mass transit, or stay the night.

That guidance also applies to air travel, which may require crossing one or more time zones:

You should not drive yourself home from the airport unless you can complete the road trip within 16 hours of the time you got up.

Even employees, who attend offsite meetings that put them back on the road in the middle afternoon, should be cautioned about the possibility of drowsy driving.

Schneider provides specific fatigue management training for drivers who operate in a team configuration (two drivers in the rig, which allows for one driver to sleep while the other drives). Continuing education that addresses how to get restful sleep, minimize the impact of daylight savings time and summer heat, and many other sleep and fatigue-related issues is also directed at employees, contractors and their families.

The Schneider executive says the investment is paying off in reduced health care costs and turnover as well as safety on the road. He also welcomes the opportunity to partner with SHSOs to educate the public and trucking industry about fatigue awareness.

For more information about Schneider National's program and working with trucking companies:

Thomas DiSalvi, CDS
Vice President, Safety
& Loss Prevention
Schneider National, Inc.
920-592-6000
disalvit@schneider.com

Hospital Policies

There are policies limiting the number of hours a health care professional may work. For example, the Accreditation Council for Graduate Medical Education (ACGME) prohibits resident physicians (doctors in training) from working more than:

- **80 hours in a week;**
- **more than 24 consecutive hours on duty (for first-year residents, second year and more senior residents may work 24 hours on duty, with an additional 4 hours to ensure safe transition of care); and**
- **more than six consecutive night shifts.**

The regulations also require on-call frequency of no more than once every third night and at least four days off per month (Ranji & Wachter, 2013).

Nurses, meanwhile, also work long as well as overnight hours. Regulations governing their time on the job are less uniform. Currently, 16 states restrict mandatory overtime for nurses, but research indicates that nurses leave work at the end of their scheduled shifts (typically 12-hours) less than 20% of the time (Geiger-Brown & Lipscomb, 2010). No regulations limit practicing physician work hours, despite evidence that many put in workdays similar to that of residents (Market et al., as cited in Ranji & Wachter, 2013).

Working long shifts increases the risk of motor vehicle crashes. Hospitals must be encouraged to take steps to ensure their staff does not end up in the emergency room as a result of driving drowsy after a long day(s) and/or night(s) of work. These include requiring sleep and drowsy driving education for all staff, monitoring residents to assess their level of impairment and fitness to drive, and providing safe rides home via for-hire services. Hospitals that do not have drowsy driving policies in place expose themselves to liability, which could make them legally responsible if a staff member is involved in a motor vehicle crash that occurs on the way home from a long day and/or night of work (Blum et al., 2011).

Determining the extent of such policies is beyond the scope of this publication, which is why SHSOs and their partners should consider

contacting hospitals and medical schools to ask about their staff-related efforts to address drowsy driving. For example, residents and faculty of the University of Arkansas Medical School (UAMS) in Little Rock, are required to complete not only a program about sleep loss and fatigue, but also the American Academy of Sleep Medicine's (AASM) web-based SAFER (Sleep, Alertness and Fatigue Education in Residency) module. All residents also receive the Graduate Medical Education Committee pamphlet on fatigue.

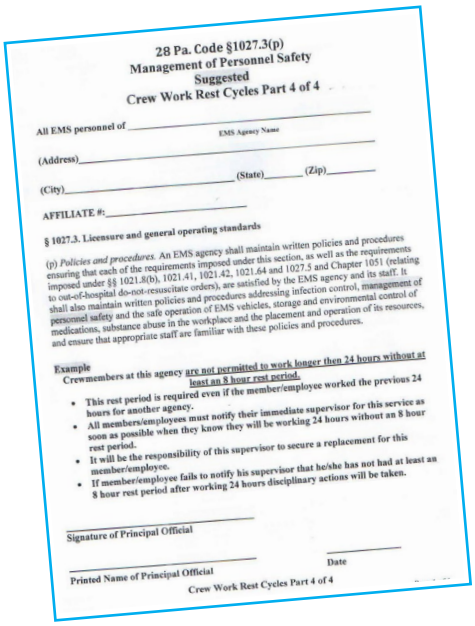
UAMS' Program Director and supervising faculty monitor the demands of individual rotations and on-call schedules, and make the necessary adjustments to reduce excessive service demands and/or fatigue. Severely fatigued residents are required to nap in a designated on-call room before returning to work or driving home. UAMS instituted one of the country's first night-float systems in 1991, where there is a day team and a resident who covers the service at night. It is credited with reducing overnight calls, thereby allowing residents and faculty to maintain a healthy education/work-life balance and, in particular, get some sleep (UAMS, 2016).

Police Agency Policies

Few police agencies have comprehensive fatigue management policies and procedures (Villa, 2011). Since SHSOs regularly partner with law enforcement, engaging agency leadership in a discussion about the extent of the problem and what they are (or can do) to mitigate it should be one of the key strategies in state drowsy driving plans. To get their attention, experts (including former law enforcement officials) suggest pointing out that fatigued officers (Vila & Kenney, 2002):

- **use more sick leave;**
- **practice inappropriate force more often;**
- **are involved in more motor vehicle crashes;**
- **experience more accidental injuries;**
- **have more difficulty dealing with community members and other law enforcement agencies; and**
- **are more likely to die in the line of duty.**

Changing the culture, however, is not likely to be easy since long hours, working nights and overtime, and on-call duty are the norm in police work. However, introducing the issue



28 Pa. Code §1027.3(p)
Management of Personnel Safety
Suggested
Crew Work Rest Cycles Part 4 of 4

All EMS personnel of _____ EMS Agency Name

(Address)_____

(City)_____ (State)_____ (Zip)_____

AFFILIATE #:_____

§ 1027.3. Licensure and general operating standards

(p) *Policies and procedures.* An EMS agency shall maintain written policies and procedures ensuring that each of the requirements imposed under this section, as well as the requirements imposed under §§ 1021.8(b), 1021.41, 1021.42, 1021.64 and 1027.5 and Chapter 1051 (relating to out-of-hospital do-not-resuscitate orders), are satisfied by the EMS agency and its staff. It shall also maintain written policies and procedures addressing infection control, management of personnel safety and the safe operation of EMS vehicles, storage and environmental control of medications, substance abuse in the workplace and the placement and operation of its resources, and ensure that appropriate staff are familiar with these policies and procedures.

Example
Crewmembers at this agency are not permitted to work longer then 24 hours without at least an 8 hour rest period.

- This rest period is required even if the member/employee worked the previous 24 hours for another agency.
- All members/employees must notify their immediate supervisor for this service as soon as possible when they know they will be working 24 hours without an 8 hour rest period.
- It will be the responsibility of this supervisor to secure a replacement for this member/employee.
- If member/employee fails to notify his supervisor that he/she has not had at least an 8 hour rest period after working 24 hours disciplinary actions will be taken.

_____
Signature of Principal Official

_____ _____
Printed Name of Principal Official Date

Crew Work Rest Cycles Part 4 of 4

Fighting Fatigue in EMS

Work is underway to develop evidence-based recommendations to help EMS agencies and practitioners address the impact fatigue has on the health and safety of patients and providers. The goal is to create voluntary guidelines, not laws or regulations. Also in development is a biomathematical model of EMS fatigue and a personal scheduling tool for agency use.

As states await the availability of these and other NHTSA-funded products, they should consider establishing policies that ensure EMS personnel get adequate rest and are not driving drowsy. For example, Pennsylvania Code §1027.3 Licensure and general operating standards, requires an EMS agency to *...maintain written policies and procedures [that] address... management of personnel safety and the safe operation of EMS vehicles...*

to both leadership and the rank and file through a series of short training sessions or a workshop that focuses on how they can work and live safer and healthier lives is a way to start. Next, have shift commanders track the number of hours officers work on and off the job in a 24-hour period and the number of hours an officer was on duty before a crash or critical incident occurred. Sharing this data with leadership and officers will keep fatigue front and center (Vila, 2011). The end game is to generate conversation that leads to meaningful dialogue and ultimately new practices and policies that everyone has a hand in crafting such as (Vila, 2011; NIJ, 2012; James & Villa, 2015):

- **Schedules that minimize shift rotation and overtime, and allow adequate time for rest (optimally 8 hours).**
- **Requiring participation in training that addresses how to effectively manage the challenges of shift-work and fatigue as well as develop healthy sleeping, eating and exercise habits.**
- **Establishing supervisor and peer-based monitoring for post-shift fatigue risks.**
- **Setting up a post-shift napping room and/or providing a drowsy officer a ride home.**

Workshops educating law enforcement leaders about the problem of drowsy police officers have been conducted in Texas (Texas Major Cities Chiefs of Police, Combined Law Enforcement Associations of Texas), California (Commission on Peace Officers Standards and Training [POST] (see *Did You Know?* pull out box); California Highway Patrol), and Washington (Seattle Police Department, Washington Association of Sheriffs and Police Chiefs), while training was conducted at Missouri's annual law enforcement conference in July 2016.

Enforcement

Drowsy driving can be confounding for law enforcement, particularly because it mimics alcohol-impaired driving and a tired driver can quickly shift into a state of alertness. An officer may pull over a motorist who exhibits the signs of being under the influence or respond to a crash that was the result of the driver falling asleep at the wheel only to discover that he or she is alert and sober. 80% of the U.S. and Canadian police officers who responded to an Internet survey, said they had stopped a driver who they believed was drunk, only to discover they were

Did You Know? SAFE Campaign

California POST created a two-minute fatigue video as part of its *Did You Know?* series for law enforcement. In addition, fatigue is incorporated into the agency's SAFE (Situation-Appropriate, Focused and Educated) driving campaign which consists of three components: an Advisory Board that concentrates on national awareness efforts; a Research Team tasked with identifying the causes of officer-involved crashes and appropriate interventions; and the Vehicle Operations and Training Council, which advances best policy and training practices (CA POST, 2016).

drowsy (AAA Foundation, 2004). Even if a motorist admits to being drowsy, what is an officer to do? Law enforcement has no blood, breath or other scientifically-validated method for measuring sleepiness at road side.

Training is Essential

Short of developing a "sleepalyzer" and a universally accepted threshold for when a motorist is too tired to drive (NSF, with guidance from scientists, defines this as getting two hours or less of sleep in the past 24 hours), training law enforcement to recognize the signs of drowsy driving is essential (NSF, 2015c). Law enforcement officials in Arkansas and New Jersey, the only states with drowsy driving laws (both have an up for 24-hours without sleep threshold, as discussed on page 23) concur, but indicated that no training was provided following enactment of their respective state statutes.

At minimum, officers must understand that driving without sufficient sleep is a form of impairment that significantly diminishes driving performance for both the general public and the officers themselves. This training must also address the fact that a drowsy driver is likely to exhibit actions similar to a drunk driver such as failure to maintain vehicle control, lane excursions/ swerving, and inconsistent vehicle speed. Unlike pulling over a drunk driver, however, the activity associated with a traffic stop (e.g., flashing lights, rolling down the window, retrieving documents) may act to revive the drowsy driver making him or her appear alert to the officer. That's why in addition to asking about alcohol-consumption, a police officer should also inquire about *how much sleep the driver has gotten.*

"If it is a routine traffic stop and not a crash, there is a good bet the driver will admit to being tired," said the Arkansas Highway Patrol (AHP) Division Commander. That is why knowing what to do next should also be addressed through training. "We instruct our officers to engage the driver in a discussion about how much sleep they've gotten in the past 24 hours. NHTSA studies indicate that the .04 to .08 range is equivalent to more than 16 hours without sleep. In that case, we take them out of the car and don't let them proceed."

While the AHP Commander indicated that an officer "could technically take the driver to a law enforcement facility," the rural nature of the state coupled with limited resources "impact an officer's decision to do that." For less extreme cases, the Commander explained that "the officer tells the driver that it would be best for his safety and the safety of others, to get off the road. The officer also lets the driver know that if he hurts or kills someone as a result of driving drowsy, he could be charged with negligent homicide. That usually works to get their attention."

Crash Investigation Training

Law enforcement officials should also receive training that covers the common characteristics of drowsy driving crashes (as described on page 9 of this report) and investigative techniques for serious injury and fatal crashes. Taking a cue from the National Transportation Safety Board (NTSB),

"We instruct our officers to engage the driver in a discussion about how much sleep they've gotten in the past 24 hours. NHTSA studies indicate that the .04 to .08 range is equivalent to more than 16 hours without sleep. In that case, we take them out of the car and don't let them proceed," said the Arkansas Highway Patrol Division Commander.

which developed a protocol for investigating fatigue-related crashes following a fatal Guantanamo Bay plane crash in 1993, the query should include a 72-hour look back to examine at least three core physiological factors:

- **how much sleep the driver typically gets at home and reported getting prior to the crash in order to calculate his or her cumulative sleep loss or debt;**
- **how many hours the driver was continuously awake prior to the crash; and**
- **the time of day the crash occurred, which can be a factor in determining when the driver typically sleeps and if there were any disruptions to his or her circadian pattern. (NTSB, 1994)**

In addition, the investigator should determine if the driver had a sleep disorder (admittedly difficult due to low diagnosis rates) or other medical condition, and/or was taking medication. The NHTSA Administrator, who was part of the team that developed the NTSB protocol, stressed that to include or exclude fatigue or drowsiness as a crash causation factor requires "looking at as many factors as possible" (Rosekind personal communication, 2016). The Bergen County (New Jersey) Detective notes that determining fatigue was the only reasonable explanation requires "exhausting all other factors."

That includes checking the vehicle's event data recorder (EDR), which can provide information on what the driver did or did not do in the time leading up to a crash. "We either get the driver's consent or a search warrant to access this information," said the Detective. "We have tools that enable us to download the EDR information to a laptop computer, equipped with software that interprets the data." While data from an EDR can be helpful for analyzing a crash, it should not be considered an appropriate substitute for a crash reconstruction.

Commercial Vehicle Stops

Trucks and buses are overrepresented in fatal motor vehicle crashes, and commercial motor vehicle drivers are a high-risk group for drowsy driving (as described on page 16 of this report). While the Federal Motor Carrier Safety Administration (FMCSA) is tasked with regulating and overseeing the safety and operations of more than 500,000 interstate carriers and approximately four million Commercial Driver's License (CDL) holders, the agency's focus is on roadside inspections and compliance review. It does not have jurisdiction to conduct traffic enforcement. That work falls to the approximately 12,000 state and local commercial vehicle law enforcement officers, who are supported through the Motor Carrier Safety Assistance Program (MCSAP) administered by FMCSA. Because MCSAP-funded law enforcement make up less than 1.5% of all police officers nationwide, it is important that the remaining state and local law enforcement officials stop and cite commercial driver license holders who violate traffic laws.

For a police officer not familiar with the regulations governing inter-

For more information about drowsy driving enforcement:

Detective Sergeant Christopher Kelley
Bergen County Prosecutor's Office
201-226-5595
ckelley@bcpo.net

Commander Mike Foster
Highway Patrol Division
Arkansas State Police
501-618-8004
Mike.foster@asp.arkansas.gov

and intrastate trucks and buses, commercial vehicle enforcement can appear daunting. But the former executive director of the Commercial Vehicle Safety Alliance (CVSA) pointed out that "a truck or a bus is nothing more than a big car" and that the top five most cited commercial driver violations are speeding, no seat belt use, failure to obey a traffic control device, following too closely, and improper lane change (Keppler, 2011). All are violations that a police official does not need specialized training to cite.

The FMCSA's Associate Administrator for Enforcement agrees. "We need local police to write the ticket," he said. "Getting these violations into the system helps us identify and monitor unsafe drivers," he said. "But we also know that the trucker may give the officer his log book [which details the numbers of hours he or she has been on the road]. If that happens, it's okay to say no thank you to the log book; the goal here is to get them comfortable making the stop."

The FMCSA official explained that as commercial vehicle operators move from paper-based (hand-written) to electronic logging devices or ELDs (federally mandated by the end of 2018), tools will become available to enable a police officer to determine at roadside if a driver is in compliance with hours of service (HOS) regulations and put him or her out of service if not. That will be an important step forward in helping to detect and remove drowsy and fatigued CMV drivers from the road. The U.S. Department of Transportation estimates that the mandate will impact three million CMV operators and have the potential to save 26 lives and prevent 562 injures annually (Carlson, 2016).

Safety experts and researchers, however, stress that "some drivers who comply with the HOS rules are fatigued the moment they get behind the wheel, [while] others become fatigued within the course of permissible hours of operation," (CVSA, 2014). Instead, they point to the value of Federal Motor Carrier Safety Regulation 392.3:

> ***No driver shall operate a commercial motor vehicle, and a motor carrier shall not require or permit a driver to operate a commercial motor vehicle, while the driver's ability or alertness is so impaired, or so likely to become impaired through fatigue, illness, or any other cause, as to make it unsafe for him/her to begin or continue to operate the commercial motor vehicle.***

Crash Investigation Training

The Florida-based Institute for Police Technology and Management (IPTM) and the National Transportation Safety Board (NTSB) offer training in fatigue-related crash investigation. IPTM's five-day, 40-hour *Human Factors in Traffic Crash Reconstruction* course devotes approximately 30-minutes to the topic with a particular focus on understanding what causes and exacerbates fatigue as well as fatigue's role in crashes, particularly those involving commercial vehicles. Some State Highway Safety Offices provide grant funding for delivery of this program in their respective states.

The two-day NTSB Investigating Human Fatigue Factors course covers fatigue-related issues at the individual, medical, operational, and environmental levels, and how these issues affect performance, alertness and safety. It also examines what information should be collected during an investigation through case studies and hands-on exercises. The course is conducted at the NTSB Training Center in Ashburn, VA.

calling it a "common-sense rule" that "provides enforcement personnel a tool to identify and take appropriate action as warranted" to "help ensure drivers do not drive while fatigued" (CVSA, 2014). The issue is highly contentious and one that has and likely will continue to be debated by Congress, federal government and trucking industry officials, and safety advocates.

SHSOs and their enforcement partners are also encouraged to work with their respective FMCSA State Field Offices and MCSAP officials to coordinate training and enforcement activities. FMCSA and MCSAP welcome the opportunity to participate in high visibility enforcement and public outreach campaigns and can provide insight on how best to engage with and message to CMV operators.

Public Awareness and Education

There is agreement among the traffic safety and public health sectors that it is time for a national drowsy driving campaign. Unlike *Click It or Ticket*, *Drive Sober or Get Pulled Over*, and *U Text, U Drive, U Lose*, however, coupling such a public awareness and education initiative with high visibility enforcement, which is essential for prompting behavior change, could be fraught with problems (e.g., no measurable test for sleepiness, a lack of state laws) as detailed previously in this report. But that should not deter states from educating the public about the problem, as well as what they can do to prevent it.

To help states, NHTSA is developing evidence-based messaging strategies that will address why drowsy driving is risky, how motorists can prevent it, the signs and symptoms (see the *Warning Signs* pull out box), and strategies for dealing with it once on the road. While everyone has the potential to drive drowsy – and likely has – this information should not only be disseminated to the general public, but also tailored to reach high-risk groups (e.g., teens and young adults, shift workers, CVM operators) via credible and authentic sources (e.g., peer-to-peer, parent-to-teen, supervisor-to-subordinate, doctor-to-patient) and through the most appropriate channel (e.g., social media, on-the-job).

As noted previously in this report, employers should be encouraged to develop not only policies, but also education programs that address drowsy driving. If an organization already has a safety and/or health and wellness program, adding drowsy driving to the mix should not be a heavy lift. In fact, it might even give a

The Warning Signs of Drowsy Driving & What to Do

Do you know how to recognize the warning signs of drowsy driving? According to the American Academy of Sleep Medicine (2015b) and AAA (2016), they include:

- **Frequent yawning or being unable to keep your eyes open**
- **Daydreaming or having wandering, disconnected thoughts**
- **Catching yourself nodding off and having trouble keeping your head up**
- **Not remember driving the last few miles**
- **Ending up too close to cars in front of you.**
- **Missing road signs or driving past your turn or exit**
- **Driving into another lane of traffic, onto the rumble strip or shoulder of the road**

If you experience any of these signs, pull over or have a passenger take the wheel. While you might think rolling down the window, turning up the radio, or stopping for a caffeinated beverage will revive you (it takes caffeine 30 minutes to take effect), sleep is the only remedy. Find a place to safely pull off the road and take a nap.

much needed jumpstart to a tired (no pun intended) program. Educating employees – and their families – about how to avoid drowsy driving, along with how sleep impacts performance behind the wheel, on the job and in the classroom are good for business. Workplace safety and health and wellness programs are found to bolster employee morale, job satisfaction, and retention, and aid with recruitment (CDC, 2013).

Online Drowsy Driving Education & Training

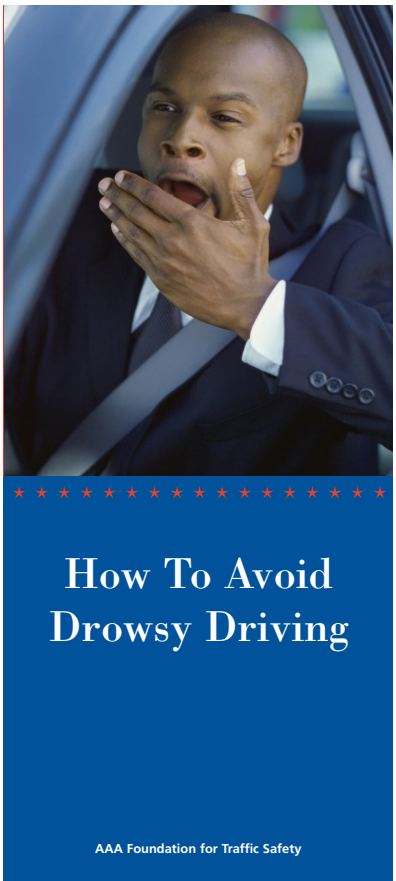
Organizations including AAA, the American Academy of Sleep Medicine, and the National Sleep Foundation make drowsy driving information available to the public via their websites. The National Safety Council makes its Defensive Driving Course available in online modules, enabling companies to provide a comprehensive training program or select from individual topics, including *Avoiding Fatigued Driving,* based on specific training needs. The 30-minute training reviews the causes and warning signs of drowsy driving, identifies high-risk groups, and discusses good sleep practices using interactive gaming exercises and testing challenges.

The North American Fatigue Management Program (NAFMP) is a free, voluntary, interactive web-based educational and training program for commercial vehicle drivers and their families, carrier executives and managers, and others in the supply chain (e.g., shippers, receivers, dispatchers). Developed through an international partnership between U.S. and Canadian government and trucking-related entities, NAFMP's ten learning modules provide information and best practices on how to manage fatigue. Guidance on health and wellness (including sleep disorders, treatment and support), time management, vehicle technologies, and scheduling best practices is provided to help CMV drivers maintain a healthy and productive work/life balance.

Any commercial driver can participate in the NAFMP, even if his or her employer does not. To bolster carrier use, a cost-benefit calculator is available to estimate the monetary benefits of implementing either the entire program or select components in a customized format. By using the calculator, a company can determine the potential total cost savings it may experience based on the total costs of implementing a customized NAFMP and the corresponding benefit of potentially reduced crash rates.

Sleep Education

Since sleep is at the heart of drowsy driving, its importance must be front and center in all education and public awareness initiatives. Addressing it in schools and the workplace, and in conjunction with play (world class athletes point to sleep as one of their most critical training tools) is needed to foster a cultural shift where people of all ages deem sleep a necessity, not a luxury – and make time for it. Education should extol the benefits of sleep – better health, decision-making, memory, performance, concentration, even sex – and how to get sleep (see *Tips for Getting a Good Night's Sleep* pull out box for more information), along with how much is enough.



Tips for Getting a Good Night's Sleep

Want to improve your sleep quality? The National Institutes of Health's *Your Guide to Healthy Sleep* (2011) suggests the following:

- **Establish and stick to a seven-day a week sleep schedule. Sleeping later on the weekends makes it harder to get out of bed on Monday.**
- **Exercise at least 30 minutes a day, but not 2-3 hours before bedtime.**
- **Avoid caffeine late in the afternoon or evening; its effects can take up to eight hours to wear off.**
- **Avoid nicotine. It is a stimulant that causes people to sleep lightly and wake early in the morning due to nicotine withdrawal.**
- **Avoid alcoholic drinks before bed, which can rob you of sleep and impair breathing.**
- **Avoid large meals and beverages late at night, which can cause indigestion and frequent urination, respectively.**
- **If possible, avoid medications that delay or disrupt sleep. Talk to your doctor if any drug you are taking is keeping you up. Ask if you can take it at other times during the day or early evening.**
- **Do not take naps after 3 p.m. They can make up for lost sleep, but late afternoon naps make it harder to fall asleep at night.**
- **Relax before bed. Read, listen to music or engage in some other relaxing activity.**
- **Take a hot bath before bed; it drops your body temperature and helps you feel sleepy and more relaxed.**
- **Have a good sleeping environment, one that is cool, comfortable and technology-free. (When was the last time you changed your mattress and/or pillow?) If you have a clock by your bed, turn the face so you do not worry about the time while trying to fall asleep.**
- **Have the right sunlight exposure. Get outside at least 30 minutes a day and turn down the lights before bedtime.**
- **Do not lie in bed awake. If you are still awake after 30 minutes or starting to feel worried or anxious, get up and do something relaxing until you feel sleepy.**
- **Consult a doctor if you continue to have trouble sleeping. You may have a sleep disorder or another physical or mental health condition that may be impacting your sleep.**

To encourage sleep education in schools, the American Academy of Sleep Medicine (ASSM) developed a suite of free, downloadable educational resources for elementary, middle and secondary school teachers that include lesson plans, activities, assessment tools, and presentations. AASM's goal is to generate interest in the study of sleep medicine and raise awareness of sleep disorders, while ensuring that children and teens recognize sleep's role in maintaining a healthy lifestyle. Each lesson plan includes learning objectives, procedures, assessments, and techniques to accommodate differences in how students learn. They are also cross-curricular, allowing teachers to adapt and use the content in math, art, health, social studies, and language arts.

SHSO might also consider partnering with their respective state or local SADD Chapter(s) or other teen driving or youth-oriented programs to encourage development of educational initiatives addressing drowsy driving and sleep (for a creative approach, see the *Jammie Session* pull out box). Peer-to-peer programs should aim to (Doheny, 2015; UCLA Sleep Disorders Center, 2016):

- **Promote the right view of sleep (it makes them, smarter, more productive and creative, and perform better) rather than the wrong view of sleep (it is something that is keeping them from the things they want to do or that needs to be conquered);**
- **Help them overcome the fear of missing out, so they are not tempted to drive when they really should be resting or sleeping;**
- **Identify how much sleep they need and what they can do to get it; and**
- **Recognize the danger signs and risks of drowsy driving and options for finding a safe ride home.**

Educating Parents of Teens

Educating parents about teens, sleep and drowsy driving is also critical. That effort should start with a brief overview of the change in their children's sleep patterns, discussed earlier in this report on page 13, and what they can do to help their teens get a good night's sleep – optimally nine to ten hours. Experts suggest the following (Tarkan, 2015; Doheny, 2015):

- **Establish a regular lights-out time that includes a limit on computer use. Doing so forces teens to focus on getting their homework done, rather than on using social media. Setting a firm limit gives teens an out with their friends –** *My parents are making me get off the computer at 10, so I have to get my homework done.*

Jammie Session Helps Teens Learn About the Importance of Sleep

The State Coordinator of Illinois SADD is making plans to include a *Jammie* Session in the Chapter's annual statewide teen training event to be held at the state capitol this fall. During the two-day *Dome Shift*, teens will participate in workshops and an advocacy march to the state house for meetings with legislators to discuss drowsy driving. The *Jammie* Session will take place on the first night; pajama clad teens, pillows in hand, will learn about drowsy driving through a presentation and activity and take a pop quiz to gauge what they learned before turning in for the night. The next morning, after getting a good night's sleep, they will take the quiz again. The exercise is designed to help them recognize the importance of sleep and how being tired can impact their decision making and driving skills.

- **Monitor extracurricular activities. Parents need to make sure teens are not so over-involved that they do not have any time to relax and unwind. When that happens, they are likely to have trouble falling asleep.**
- **Remove any device with a screen from the bedroom and get teens off screens two hours before bed time, if possible. Many teens use their phone as an alarm clock. Taking it to bed can prompt them to keep checking for messages and engage in conversations that keep them up half the night.**
- **Keep tabs on caffeine. While soda consumption by teens is down, they are drinking more caffeinated beverages including coffee, iced tea and energy drinks that can remain in the system for up to eight hours.**
- **Roust them by 9 or 9:30 a.m. on the weekend. Catching up on sleep could cause teens' body clocks to shift, making it even harder to get out of bed on the next school day.**
- **Seek professional help if their teen simply is not sleeping or sleeping too much. A change in sleep patterns is one of the first symptoms of depression.**

When it comes to drowsy driving, parents need to set clear rules, including insisting their teens be well-rested before handing over the keys, warning them about looking out for the other guy who may be doing something unsafe (to react, they have to be awake and alert), recognizing when they are simply too tired to drive (see the Warning Signs pull out box on page 39), and teaching them what to do if they are sleepy on the road (Doheny, 2015). Most importantly, parents have to be prepared to say no to their teens going out even if they insist they are okay to drive.

Putting a Face on Drowsy Driving

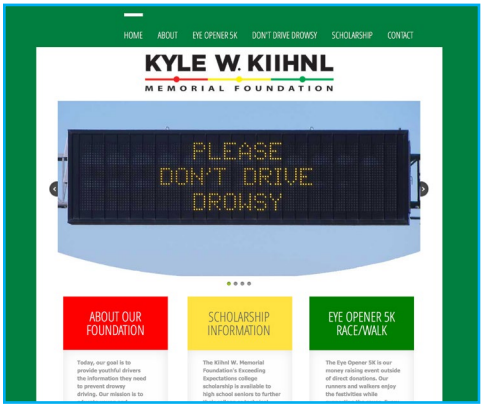
Just like other forms of impaired driving, it is important to put a face to those who have lost their lives because they or another person got behind the wheel with too little sleep. Victim advocates, working in states across the U.S., can be critical partners in helping to educate the public about the danger and consequences of drowsy driving. As the following examples illustrate, victim advocates bring a unique and important perspective to the discussion.

Tennessee

Kyle Kiihnl was a Shelby County, TN high school freshman, who was struck and killed while he was walking on a sidewalk. He was hit by a a young drowsy driver who fell asleep at the wheel and drifted onto the sidewalk. Kyle's family has been working for more than a decade to call attention to the problem. Partnering with high schools, driving schools and community groups, Kyle's aunt, Kathi Wright, said the family is educating teens, parents and adults about the importance of sleep. "We stress how dumb it is to get a couple hours of sleep and get behind the wheel. We also remind parents that their schedules revolved around

their kids' nap time, but that isn't the case in their teen years. Sleep is just as important for our kids in their teen years."

The Kyle W. Kiihnl Memorial Foundation worked with the State Highway Safety Office to get a *Please Don't Drive Drowsy* message included in the mix of safety messages regularly posted on highway variable message boards across the state. The message has also been played on the TN Highway Advisory Radio channel in urban areas. The Foundation sponsors an annual Eye Opener 5K run/walk to raise funds that are used to educate drivers at rest stops and award college scholarships to local students.

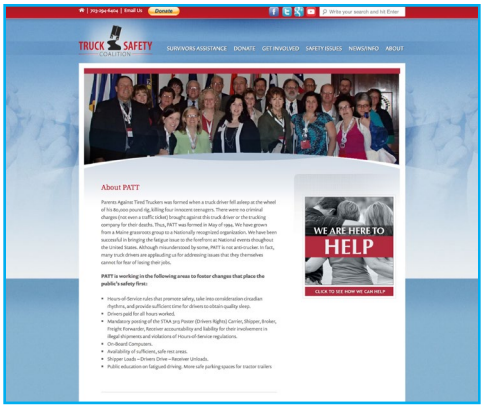


Massachusetts

Massachusetts native, Jim Berkowitz was just 24-years-old when he fell asleep at the wheel driving back to Wake Forest Law School and was killed. He had set out on the six-hour drive to North Carolina just after the start of daylight savings time, which can be jarring to the body. His sister, Marian, has been working ever since to find a way to address the problem. She was a driving force behind a 2008 drowsy driving report submitted to the state legislature, worked with a college health communications class to develop drowsy driving messaging, and is lobbying for a bill that would designate the second week of November as Drowsy Driving Prevention Week. She has also worked with the SHSO to have a drowsy driving message posted on the state's variable message boards on highways across the state.

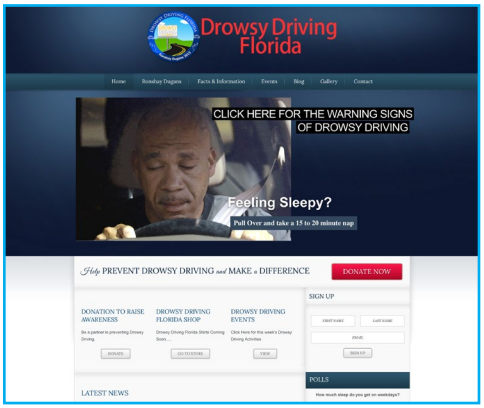
Maine & Nationwide

Parents Against Tired Trucks (PATT) was formed in Maine in May 1994, when a truck driver fell asleep at the wheel of his rig killing four teens. More than two decades later, the grassroots group is a national organization dedicated to bringing fatigue to the forefront at events across the U.S. While some consider PATT to be anti-trucker, the organization says that it is applauded by many truck drivers "for addressing issues that they…cannot for fear of losing their jobs" (The Truck Safety Coalition, 2016). In addition to working on hours of service rules and other truck-related policy and regulatory issues, PATT's First Response Program provides immediate and compassionate support to survivors and families of victims of truck crashes through a network of local volunteers.



Florida

The Sunshine State's *You Snooze, You Lose* campaign was instituted after passage of the Ronshay Dugan Act in 2010. Named after the eight-year-old who died of head trauma when the Boys and Girls Club bus she was riding in was struck by a cement truck operated by a drowsy driver, the legislation designates the first week of September as Drowsy Driving Prevention Week in Florida. It also calls on the Departments of Highway Safety and Motor Vehicles and Transportation (FDOT) to educate law enforcement and the public about how driving drowsy is a form of impairment that is just dangerous as driving drunk (Florida Legislature, 2011). The two state agencies issue a joint press release to kick off the week and call attention to the problem.



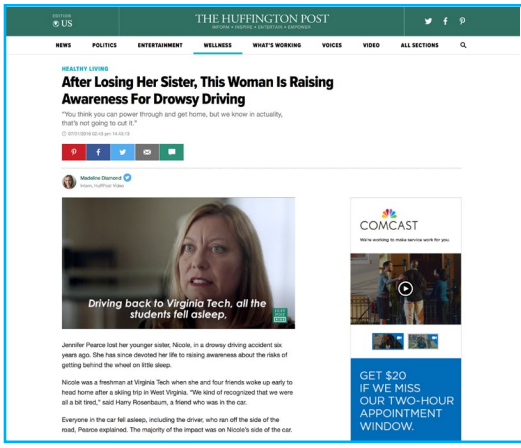
In addition, FDOT's website discusses what causes drowsy driving, who is most at risk, what to do, and where to find more information. It features links to a variety of resources, including Drowsy Driving Florida, a website established by Ronshay's family, and the state's network of rest areas, service plazas and truck stops.

Maryland & Nationwide

Jennifer Pearce never thought she would become a drowsy driving advocate, but she was compelled to act after the death of her sister Nicki in 2008. The Virginia Tech freshman was killed when the vehicle she was riding in with three other friends hit a tree head on. State police said alcohol or excessive speed were not factors in the crash and the driver fell asleep at the wheel. "There were no skid marks or [signs of] braking; [the driver] hit a tree on my sister's side of the car at full speed," explains Jennifer.

Talking to motorists at rest stops in Maryland ultimately led to an appearance on the *TODAY Show* in 2014, participation in NHTSA's Asleep at the Wheel conference last year, and a full schedule of speaking engagements at state and national conferences through 2016. "For seven years, I didn't know people were taking an interest in drowsy driving," she said. "I'm so pleased that's now getting national attention. But we need a MADD for drowsy driving."

To that end, Jennifer is working to establish a 501(c)(3) that will focus on educating the public about the importance of sleep and the critical role it plays in safe driving, as well as helping victims turn their grief into advocacy.



Jennifer Pearce never thought she would become a drowsy driving advocate, but she was compelled to act after the death of her sister Nicki in 2008. The Virginia Tech freshman was killed when the vehicle she was riding in ... hit a tree head on.

Engineering

Engineering improvements are helping to make roadways and vehicles safer for drowsy drivers. While SHSOs are tasked with addressing behavioral safety issues, it is important to educate motorists about how infrastructure improvements and in-vehicle technology work to help prevent drowsy driving and fall asleep crashes. Additionally, states can use Section 154 (Open Container) and 164 (Repeat Intoxicated Driver) transfer program funds for hazard elimination infrastructure projects such as the installation of rumble strips (see below).

Rumble Strips

Rumble strips – raised or grooved patterns placed on the roadway surface that produce both a loud noise and a vibration when a vehicle's tires travel across them – are a proven and cost-effective tool for reducing drowsy driving crashes. When placed along the shoulder of the road, they alert drivers when they are drifting or about to run off the road. When placed along the centerlines, they make drivers aware that they have crossed into an opposing travel lane. Installation of rumble strips is inexpensive compared to other infrastructure improvements (about $1,000-$1,500 per mile). Evaluations indicate that they can reduce lane departure crashes by 50% or more, depending on the location (NHTSA, 2016).

Most states have adopted policies that require or encourage the use of shoulder rumble strips on rural interstates and interstate-like roadways. They also are increasingly being used on rural two-lane roadways. Motorists, particularly novice drivers, need to be educated about how rumble strips work as an alarm clock to alert them when they are drifting off the road or into another lane. That explanation should also include the caveat that rumble strips are not the solution for tired or sleepy drivers, but a wake-up call that they need to get off the road.

The free Roadway Safety Foundation (RSF) video and accompanying brochure – *Recognize, React, Recover* – discusses how rumble strips help prevent run-off-the-road crashes. Through six modules, novice and experienced drivers are introduced to the causes and consequences of these crashes, hear real-life stories, and learn about the lifesaving and cost-effective benefits of rumble strips. Professional drivers also offer tips for recovering from a roadway departure. RSF also worked with tribal and national transportation experts to develop free materials promoting the installation of rumble strips on roadways in Native American communities. The *Rumble on the Reservation* series includes an 11-minute video, posters and a PowerPoint presentation (RSF, 2016).

Median Cable Barriers

Many states are also replacing guardrails with median cable barriers to help reduce cross-median, head-on collisions that typically result in serious and/or fatal injury. The barriers are made of three or four steel cables strung on posts. When a vehicle hits the barrier, the posts break and the cables flex, absorbing much of the crash forces. This redirects the vehicle along the median, preventing a cross-median crash. They are much less expensive to install compared to concrete and metal beam barriers ($140,000-150,000 per mile versus $400,000-500,00 per mile), with repair and maintenance costs off-set by the safety benefits (FHWA, 2015; Minnesota Department of Transportation [MnDOT], 2016). Most states that have installed cable median barriers report a decrease in cross-median crash fatalities of 90% or more (Ray, 2007).

SHSOs may want to review the Minnesota Department of Transportation's website, which provides a succinct, driver-friendly explanation of how median cable barriers work from both a cost-benefit and safety perspective. They are a key strategy in the state's *Towards Zero Deaths* program. Since first installed in Minnesota in 2004, cable median barriers are credited with saving 80 lives (MnDOT, 2016).

Rest Areas

Sleep is the most effective countermeasure for combating drowsy driving. A rest area provides tired motorists a place to safely pull off the road and take a nap. Numerous studies point to the importance of rest areas for helping to make driving safer, however, they are typically located on interstates rather than rural roadways where there may be few or no places to safely pull

off the road. Since building full-service rest areas is expensive, states are encouraged to provide a variety of options for safe stopping, ranging from smaller rest areas with basic amenities to roadside parks with minimal or no services. Highly visible signage should alert motorists about the location of rest areas and encourage motorists to take a *rest* or *safety break* (see Utah's signage initiative on page 53).

The distance between rest areas is also important. A study conducted by Taylor and Sung (1998) investigated fatigue-related truck crashes on interstate highways and how they related to the availability of rest areas. The key finding was that the probability of nighttime, single-vehicle truck crashes increases exponentially when the distance between rest areas is more than 30 miles. Further findings indicated that the distance between rest areas should not exceed 55 miles due to the increased likelihood of crashes (MnDOT, 2016). States are encouraged to inventory their rest area facilities paying particular attention to the needs of all drivers (i.e., adequate space for parking big rigs) and explore options for expanding existing and/or constructing new facilities.

Motorists taking road trips of two or more hours in duration should determine not only the best route, but also the location of areas where they can stop and rest along the way. (This is a key component of journey management discussed previously on page 31.) A number of websites such as Interstate Rest Areas and RoadNow and free or low-cost apps for both Apple and Android devices are available to assist motorists locate rest areas on roadways across the U.S. Some states also provide online inventories that can be accessed by the public.

Vehicle Technology

Is the vehicle the answer to the drowsy driving problem? Automotive manufacturers and researchers have developed technologies that detect variations in driver performance and issue a drowsiness warning. Recent NHTSA research also indicates that algorithms based on driver performance measures can detect drowsiness and predict lane departures (Brown et al., as cited in NHTSA, 2016), which accounts for 1.6 million collisions a year (AAA Foundation, 2014). These systems, which go by names such as Attention Assist, Driver Alert, Driver Attention Alert, Lane Departure Warning, and EyeSight, all essentially work the same. However, they are typically not sold as standard features, but available as upgrades to base models or on higher-end vehicles, thereby limiting their adoption.

Understanding the human factors associated with these devices, particularly how drivers respond to warning signals and their effectiveness in prompting the appropriate driver action, is critical (NHTSA, 2016). NHTSA, in collaboration with original equipment manufacturers (OEMs), suppliers and aftermarket producers, began a project in 2015 to explore currently available drowsy detection and alerting systems and their effectiveness. Particular focus is being given to assessing the warnings or cues (e.g., a red coffee icon) that motorists receive, to determine whether they are sufficient to

prompt an immediate remedy such as stopping to rest or longer-term changes to their sleep behaivor.

There are other in-vehicle technologies that, while not specifically designed to prevent drowsy driving, can be helpful in preventing crashes resulting from sleepy drivers who fail to react or see a danger. For instance, Adaptive Cruise Control (ACC) senses where a vehicle in front of you is relative to your own vehicle, and slows down and speeds up your vehicle to maintain consistent spacing. Forward Collision Mitigation (FMC), meanwhile, detects how far and fast the vehicle in front of you may be moving and automatically applies the brakes if you do not respond. Both have the potential to reduce rear-end collisions – ACC by helping the driver maintain a safe speed and following distance, and FCM by alerting the driver to a potential collision and taking pre-emptive action to avoid it (AAA Foundation, 2014).

Forward Collision Warning (FCW) systems alert you when your vehicle is about to collide with another vehicle some distance ahead of yours. The warning varies by vehicle (e.g., flashing light, alarm, vibration), but unlike Forward Collision Mitigation, FCW does not automatically apply the brakes. Lane Departure Warning (LDW) is perhaps the technology that has the most applicability to drowsy driving prevention. It works by looking at the road's lane markings and alerts the driver, via an alarm or vibration in the steering wheel or seat, when he or she unintentionally drives to close to the lane edge. LDW, however, is not Lane Departure Prevention, which may also be known as lane keeping assistance. Warning systems provide a warning, but the driver must take the necessary corrective action. Prevention systems gently steer the vehicle so it automatically re-centers in the lane (AAA Foundation, 2014).

To help motorists understand the benefits of these and other safety technologies, AAA developed a web-based Vehicle Safety Technology Ratings Matrix that uses both a 5-star rating (5=best) and an open star rating. The open star rating represents how the technology performed under tightly controlled laboratory, driving simulator or test track conditions. The 5-star ratings indicate how each technology performed in the real world as determined by crash and insurance claims data. By hovering over each technology name, a motorist can learn what the system or device does. Clicking anywhere on a specific technology will take you to a page that discuses it and the ratings in more details (AAA Foundation, 2014).

Volvo Pledges Serious Injury/ Death-Free Vehicles by 2020; Automatic Breaking to Be Standard By 2022

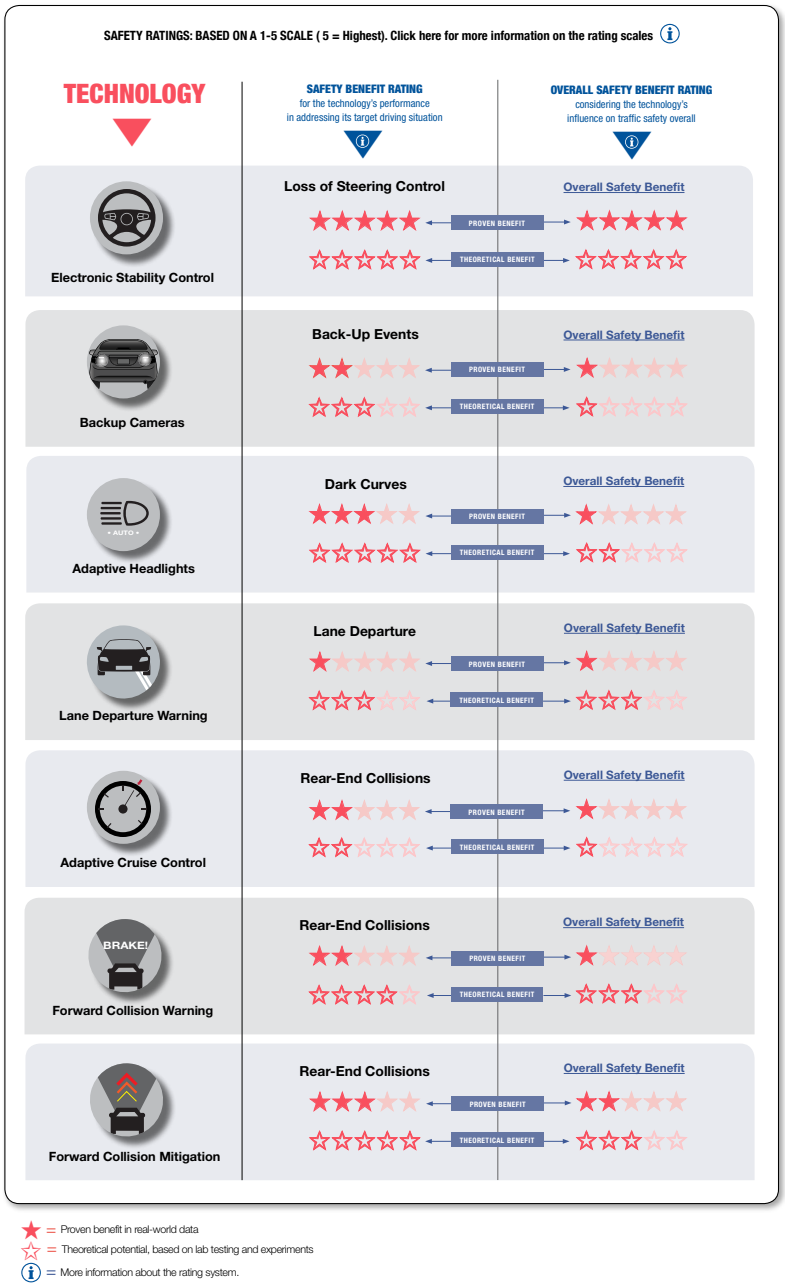
Volvo has pledged that by 2020, no one will be killed or seriously injured in a new Volvo Car or SUV. While the claim might seem impossible, according to IIHS data, from 2009 to 2012 (the most current period for which is data is available), no one in the U.S. died in nine Volvo models. Volvo tracks how many people die in its vehicles to monitor how much safer their vehicles are when they add a new crash prevention technology. That helps the Swedish-based car company predict how much safer its vehicles will be with each new advancement (Valdes-Dapena, 2016).

In the meantime, twenty automakers pledged earlier this year to make automatic emergency braking a standard safety feature by 2022. Several days later, Lexus and Toyota committed to make that happen by 2017. Automatic braking, which is currently offered on many models, uses cameras, radar and other sensors to determine if a crash is imminent and automatically apply the brakes. IIHS said that implementing this industry-wide, would save thousands of lives and prevent millions of crashes but add little to the cost of a vehicle (Martinez, 2016; Toyota U.S. Motor Sales, 2016).

While the AAA Foundation website helps drivers evaluate the safety impact of in-vehicle technologies, the National Safety Council's (NSC) recently launched website MyCarDoesWhat.org, helps drivers understand how these and a myriad of other safety features work. Developed in partnership with the University of Iowa Public Policy Center, the website uses videos, graphics, animation, social media, and other resources to educate drivers about the ever-changing world of car safety features. Regardless of the feature or make and model of the vehicle, the website quickly and easily helps you answer the following questions:

- **How do I find out what an icon or warning means?**
- **How do I use these features the way they were intended?**
- **What other types of features are out there similar to the ones I like?**
- **What features should my car have, and what features will be mandated in the future?**

NSC cautions, however, that the most advanced safety features are not a replacement for a safe, focused driver. In fact, the campaign's goal is to explain how best to use these safety technologies, leading to safer driving. That is why the video and supporting web content explaining the drowsiness alert feature, for example, not only discuss how it works, but also reminds motorists to always drive alert and well-rested, and never get behind the wheel if they are feeling drowsy (NSC, 2016).



State Best Practices

The GHSA survey conducted for this report indicated that states are addressing drowsy driving, but four – Iowa, New York, Texas, and Utah – are highlighted as best practices to help SHSOs and other organizations build or bolster their own drowsy driving toolkits. Each of these states collects drowsy driving data on their crash reporting forms as well as partners with public and private sector organizations to educate the public about the issue. They are also leveraging enforcement, engineering and/or policy initiatives discussed previously in this report to combat drowsy driving.

Iowa

- **Crash reporting**
- **Behavioral surveys**
- **VMS messages**
- **State Patrol presentations, CMV training & visor card**
- **Statewide drowsy driving summit**
- **Hy-Vee grocery store partnership**

In addition to analyzing crash data, the Hawkeye State also surveys motorists to better understand the extent of its drowsy driving problem. In 2015, motorists visiting state licensing agencies were asked by researchers from the University of Iowa (UI) to complete a traffic safety behavioral survey that included the following drowsy driving questions:

- **Have you ever fallen asleep while driving?**
- **How often do you get drowsy while driving? (daily, once a week, once a month, once a year, never)**
- **How often do you briefly doze off while driving? (daily, once a week, once a month, once a year, never)**
- **What causes you to become drowsy while driving? (not enough sleep, after eating, long drive, driving at night, a combination of these things, nothing/don't get drowsy, other)**
- **Have you ever crossed the centerline or dropped onto the shoulder of the road because you were driving drowsy?**

More than a third of motorists indicated that they get drowsy while driving at least once a month, with just over 10% saying it happens at least weekly. Even more concerning is that nearly 15% of motorists admitted to briefly dozing off behind the wheel at least once a month. A long drive and not getting enough sleep were the two most prevalent reasons cited for becoming drowsy while driving (UI, 2015).

Message Mondays

To call attention to the problem, the Department of Transportation (IDOT) now includes reminders about the dangers of driving drowsy on its 80 variable message signs located on highways across the state. Six days a week the signs are blank, unless an emergency message is posted to warn motorists about traffic delays or approaching storms. At the start of every new work week, the signs convey a three-line safety message – part of its now three-year-old *Message Monday* series – followed by the number of traffic fatalities in Iowa year-to-date. They are intentionally kept short and only posted once a week to catch motorists' attention.

A drowsy driving message posted in mid-February asked, *Winter blues? Do not snooze while you cruise*. "We do not want [a message] to be mundane," said the IDOT traffic safety engineer who leads the six-member Committee tasked with creating them. "We want it to resonate with drivers and spark conversation. If someone is passionate enough to talk about it in their car or to someone else, maybe they will get on their computer and dig a little further." That is why IDOT's *Transportation Matters* blog discusses each *Message Monday* posting and offers additional information. The drowsy driving installment included NSF tips along with a link to an AAA video discussing the warning signs of drowsy driving and how to prevent it.

To call attention to the problem, the Department of Transportation (IDOT) now includes reminders about the dangers of driving drowsy on its 80 variable message signs located on highways across the state.

IDOT has conducted studies to ensure that the signs are not causing delays or crashes resulting from distracted drivers. Motorists have also called IDOT expressing appreciation for a particular message and to offer suggestions, all of which are considered by the committee.

State Patrol Initiatives

To address the large number of serious crashes involving commercial motor vehicles (CMVs) in Iowa, the State Patrol increased the number of troopers assigned to MCSAP. These officers are trained to perform Level 3 CMV driver inspections which focus on driver qualifications and hours of service regulations. All troopers are also now required to complete FMCSA training to enhance their knowledge of the dangers posed by unsafely operated buses and large trucks. The training has been modified to include hours of service rules to address drowsy driving. A visor card that includes talking points about the extent of the truck crash problem and common violations (with the appropriate Iowa statute code) troopers should be alert for, including operating while fatigued, has been developed to aid with enforcement.

The Iowa State Patrol (ISP) also developed a presentation for schools, businesses and service/community organizations to educate the public about drowsy driving. In addition to explaining the extent of the problem, who is most at risk, and the warning signs, the presentation also addresses how to prevent it. Photos and video from actual drowsy driving crashes are shared with the audience along with information about countermeasures that can help such as rumble strips, in-vehicle technology, commercial vehicle enforcement, and rest areas. The State Trooper concludes with a summary of actions motorists can take to protect themselves and a reminder that the most dangerous mile is "the one ahead of you" so "be awake for it" (ISP, 2016).

Statewide Summit & Hy-Vee Partnership

Earlier this summer (June 2016), the Governor's Traffic Safety Bureau (GTSB) convened a statewide drowsy driving summit at the University of Iowa. Traffic safety practitioners, law enforcement, elected officials, community and business partners, and researchers, were joined by the NHTSA Administrator, who discussed the extent of the problem and the agency's efforts to address it (discussed earlier in this report on page 20). Summit attendees developed short and long-term goals and strategies leveraging the four Es – education, enforcement, engineering, emergency medical services – of traffic safety.

For more information about Iowa's drowsy driving activities:

Patrick Hoye
Bureau Chief, Governor's Traffic Safety Bureau
515-725-6120
hoye@dps.state.ia.us

GTSB is also partnering with the Hy-Vee supermarket chain to print drowsy driving tips on grocery bags and produce a public service announcement. Hy-Vee operates 230 retail stores in Iowa and seven other Midwestern states (IL, KS, MN, MO, NE, SD, WI). The grocery chain actively promotes health and wellness through in-store and mobile retail health clinics.

Utah

- **Crash reporting & data analysis**
- **Surveys & safety plans**
- **Freeway signage**
- **Sleep Smart. Drive Smart Alliance**
- **Drowsy Driving Awareness Week**
- **GDL parent nights & driver testing**
- **CMV enforcement**

Drowsy driving is a year-round issue in Utah, a state with long stretches of roadway that safety officials admit often do not offer "much to look at." The "nature of our geography," they explained, results in "many run-off the road crashes." In fact, crashes in rural Utah are three times more likely to involve a drowsy driver (Utah Highway Safety Office [UHSO], 2016). To fully understand and combat the problem, the state makes data collection and analysis a priority. The state's annual crash summary, compiled by the Utah Department of Public Safety (UDPS), includes a drowsy driving section. Information is pulled from that report to develop a drowsy driving fact sheet that is posted on the Utah Highway Safety Office (UHSO) website for access by its partners and the public.

Drowsy driving is one of 12 emphasis areas in the state's recently updated Strategic Highway Safety Plan (SHSP) Version 4.0 . It calls for the implementation of priority strategies using all four E's such as installing rumble strips at high crash locations, supporting educational activities, improving crash reporting, and increasing the involvement of emergency service providers in drowsy driving programs and community events (Utah Department of Transportation [UDOT], 2016). The state's Highway Safety Plan amplifies these strategies and includes a performance measure specifically addressing drowsy driving including the number of Utah drowsy driving-related fatalities (UHSO, 2016). UHSO's behavioral safety survey also includes the question, *how often do you drive drowsy?*

Drowsy driving is a year-round issue in Utah, a state with long stretches of roadway that safety officials admit often do not offer "much to look at." The "nature of our geography," they explained, results in "many run-off the road crashes." In fact, crashes in rural Utah are three times more likely to involve a drowsy driver.

Freeway Signage

Freeway signage is one of the engineering countermeasures the Utah Department of Transportation (UDOT) uses to reduce drowsy driving crashes. Installed on interstate and state highways including I-80 and I-70, the signs carry three different messages – *Drowsy Driving Causes Crashes*, *Drowsy Drivers Next Exit 5 Miles*, *Drowsy Drivers Pull Over If Necessary* – with the tag line, *Fatigued Ø Driver* (Schultz & Young, 2007). A study conducted by researchers at Brigham Young University, found that the signs helped reduce drowsy driving crashes from 5% to as much as 63% depending on the roadway (Schultz & Young, 2007). (The researchers noted that the crash reduction may also have been impacted by other factors such as traffic, weather, driver behavior, and police report accuracy.)

In addition to analyzing crash data, the study also included a pre- and post-signage installation survey of motorists conducted at rest stops on I-80. Of the drivers who saw the signage, 33.6% said the signs *definitely* or *somewha*t contributed to their decision to stop and take a break. Of the drivers who admitted to stopping due to drowsiness (at least one of the reasons they gave for taking a break), 71.1% indicated that the drowsy driving signs *definitely* or *somewhat* prompted that decision (Shultz & Young, 2007).

Sleep Smart. Drive Smart Alliance

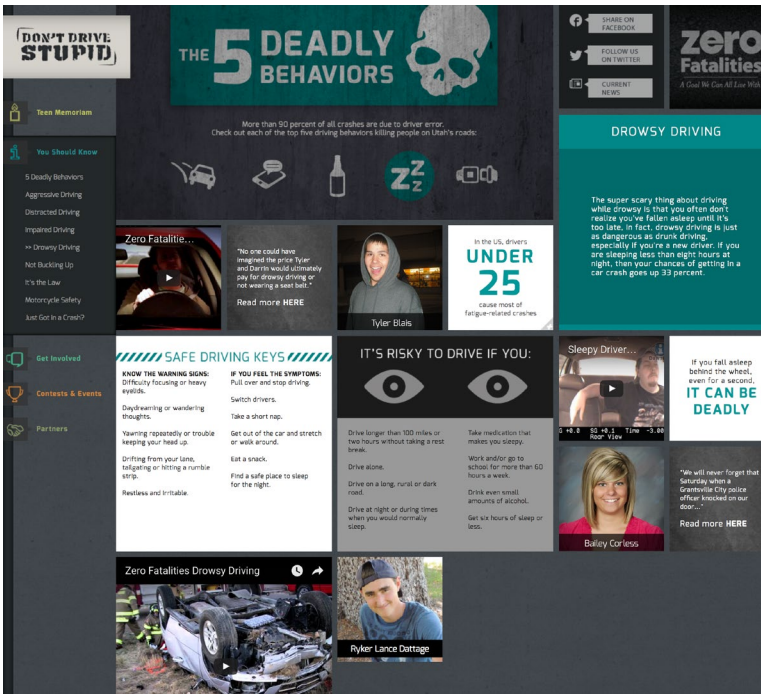
Utah's *Sleep Smart. Drive Smart Alliance* was formed in 2005 by UDOT, UDPS, the Utah Highway Patrol, and Med One, a medical equipment finance company headquartered in Sandy, UT. The Alliance's sole purpose is to educate the public about the hazards of driving sleepy. It does this through school and community-based educational initiatives, earned media activities, a website, and social media. The legislature designated the third week of August as *Drowsy Driving Awareness Week* in 2014. The Alliance conducts an annual media event to generate awareness of the impact of sleep – or the lack thereof – on driving.

In 2014, members of the media were invited to chronicle the performance of volunteer drivers (on a closed course) who had been up for 24 consecutive hours. The following year, the press became a part of the experiment. They not only drove after being awake for 24 or more hours, but also were hooked up to a polysomnography test to show that they were nodding in and out of sleep. For 2016, the Alliance has expanded its effort to include the entire summer driving season, with a focus on empowering passengers to act as the co-pilot and give the driver a break by periodically taking the wheel.

The Alliance posts drowsy driving messages on highway variable message signs, and Twitter and Facebook throughout the year. It also partners with victim advocates to humanize and personalize the issue. For example, Alliance members have helped to staff motorist engagement events conducted by NODD (*No Drowsy Driving awareness*), which was established in memory of Ronnie Lynn Thompson, a passenger who was riding with a drowsy driver. In 2015, the video, *Remembering Madeline*, was released to share the story of Brigham Young University students, Taylor, Bailee and Madie Morris, who, while traveling home for Thanksgiving, fell victim to drowsy driving. Taylor and Bailee survived, but Madie did not.

GDL Parent Nights & Driver Testing

A GDL Parent Night has been a component of Utah's Don't Drive Stupid teen safe driving program since 2011. The highly impactful presentation covers the state's five most deadly driving behaviors: driving distracted, aggressively, impaired, drowsy, and unrestrained. The program helps parents recognize the crash risk for teens and the importance of parental involvement. It also addresses Utah's graduated driver license (GDL) law, which includes a nighttime driving restriction. A 40-page parent guide includes information about the extent of the drowsy driving problem, the risks and warning signs, and links to information about two Utah teens who were killed in drowsy driving crashes. It also points out that drowsy driving is a Class C Misdemeanor (careless driving) that could result in license revocation (UDPS, 2016).



While parents are not required to attend a GDL Night, the statewide driver education curriculum includes a parent night as a core standard. Utah's largest school district, which includes eight high schools, has made the program a mandatory component of its driver education program.

Legislation that took effect on January 1, 2016, requires novice drivers to pass an online, open book test after they complete driver education and before taking the written exam required to obtain a learner's permit. HB147 was prompted by a 16% increase in traffic fatalities in 2014. The Traffic Safety and Trends Exam consists of 40 questions covering safe driving topics and the top five causes of traffic-related deaths as identified by UHSO, which includes drowsy driving. A student must score 100% on the exam and may take it as many times as needed. Both a printable study guide and fact sheet are provided on the DPS website (Davidson, 2016).

UDOT Motor Carrier Division

The Utah DOT Motor Carrier Division's Drive to Stay Alive program educates CMV drivers about eight prevention focus areas, one of which includes driving drowsy. The initiative also provides information about the location of rest stops and parking areas along major roadways across the state. An online quiz to test truck drivers' knowledge about safely driving a big rig includes four drowsy driving related-questions. It can be accessed from both the Motor Carrier Division and Utah Trucking Association websites.

For more information about Utah's drowsy driving initiatives:

Robyn LaLumia
Impaired Driving Program Manager
Utah Highway Safety Office
801-573-2842
rlalumia@utah.gov

Texas

- **Data collection**
- **Our Driving Concern**

The Texas Department of Transportation captures *fatigued or asleep* as a contributing factor on its crash reporting form. From 2013 through 2015, there were 27,996 reportable crashes attributed to a drowsy driver; 11,647 resulted in an injury, while 552 led to a fatality.

Our Driving Concern

To combat the problem, TxDOT partners with the National Safety Council to fund *Our Driving Concern* (ODC): *Texas Employer Traffic Safety Program*. The ODC program is designed to help public and private sector employers promote safe driving practices among their employees, both on and off the job, and proactively combat the costly toll of crashes by helping them understand risky driving behaviors and liability exposure. ODC makes a suite of free resources addressing distracted, aggressive and impaired driving (the latter includes drowsy driving); occupant restraint use; and other traffic safety topics available to mangers, human resource professionals and safety instructors for use in building and maintaining a company-wide traffic safety program.

Resources include train-the-trainer workshops (conducted across the state), webinars (from 15-60 minutes in length), twice monthly e-newsletters, brochures, and posters along with materials designed to engage employees in quick chats about traffic safety. These resources may be used by any employer in the U.S. *Safety Coach Tailgate Talks*, for example, are short lessons that can be delivered to a small group of employees outside of a traditional classroom setting. The *I'm a Shift Worker… I Can't Help Being Sleepy!* talk features four strategies shift workers can use to drive safely to and from work. Others review the warning signs of drowsy driving, common causes, and the extent of the crash problem.

A series of cards featuring discussion prompts with suggested answers are also available to support the *Tailgate Talks*. Supervisors can use all of the cards for one topic to deliver a complete safety lesson or mix them up for a Jeopardy-style game. The cards are provided, eight per sheet with instructions for creating a set of 48 cards. Toilet tabloids, meanwhile, deliver traffic safety information to a captive audience. Each tabloid, which is designed for posting on the doors or walls of bathroom stalls, uses vivid images and stats (e.g., *Drowsy driving is a form of impaired driving that negatively affects a person's ability to drive safely*) to engage and educate employees.

To encourage employers to take advantage of ODC, a workshop addressing the value of making traffic safety a part of a company's safety culture is offered regularly at statewide and regional conferences across the state. Several PowerPoint presentations, dubbed Power Plays, address why developing an employee safety program is good for business. *Occupational Driving Safety Programs: The Driver*, for example, discusses the driver behavior, skills and physical conditions that affect driving, including fatigue.

To encourage employers to take advantage of ODC, a workshop addressing the value of making traffic safety a part of a company's safety culture is offered regularly at statewide and regional conferences across the state.

An advisory committee also provides guidance and input to the Texas-based, NSC Program Manager who oversees the initiative. She works with statewide organizations including the National Federation of Independent Business, the Texas Trucking Association, the Society for Human Resource Management (SHRM) as well as the OSHA STEPS (National Service, Transmission, Exploration & Production Safety) Network, which works to reduce injuries in the oil and gas industry, and the Texas Department of Insurance.

"I often receive calls from business officials who say, my insurance company told me to call you because we're costing them too much money," she noted. "My response is that investing in a traffic safety program can improve your bottom line by reducing liability, health care costs, lost productivity, and many other expenses resulting from employee crashes."

Many county and municipal governments are also active users of ODC. One of those is Harris County, which employs approximately 700 and covers the 1,800 square miles that surround the city of Houston. It is the largest county in Texas and the third largest in the nation. Any employee who drives a county-owned vehicle or a personal vehicle on County business more than twice a week must complete the NSC's Defensive Driving Course (DDC).

In addition to administering the DDC, the County's Mosquito Control Division is a regular user of the ODC materials. The Education/Training Assistant conducts weekly *Just In Time* defensive driving training in the off-season that is mandatory for any of the Division's 45 employees who were involved in a crash the previous year. There were only four employees mandated to attend in 2016, however, the sessions regularly draw 20 or more. What brings them in?

"I conduct the training in the morning, keep it to an hour, make it interactive, use short videos and stats to reinforce the safety information, and end with a quiz. The first team to correctly answer all of the questions wins a prize," said the Education/Training Assistant. "Much of the content is pulled directly from the ODC materials, and I use items from NSC as giveaways."

Drowsy driving is the newest training topic. A ten-slide presentation discusses why it is so difficult to attribute crashes to sleepiness; in-vehicle and after-market technologies, and roadway features that can help protect drowsy drivers; the warning signs of drowsy driving; and good sleep hygiene. "Adding this to our safety curriculum is important because during mosquito season half of our employees work the nightshift," explained the Education/Training Assistant. "That impacts their circadian rhythm and sleep patterns, elevating the risk of being drowsy behind the wheel."

The NSC Program Manager concurs that the program can have a ripple effect. "I regularly conduct train-the-trainer sessions [that include fatigue and drowsy driving] and encourage the participants to not only roll out the information to all their employees, but also to share it in their communities. A Boy Scout leader will use it with his troop, a librarian will promote it to patrons, and a grandmother will discuss it with her grandson – a teen driver. The information goes much further than employee to employee, it is getting out into the community."

For more information about the ODC Texas Employer Traffic Safety Program:

Lisa Robinson, CFLE
NSC Program Manager
312-466-7383
Lisa.robinson@nsc.org

New York

- **Crash reporting & medical review**
- **Drowsy Driving Partnership**
- **Driver education**
- **Later school start time**
- **Law enforcement training**

New York does not require doctors to report medical conditions (as discussed on page 31 of this report). But it does monitor crash reports for specific causation factors, including *fatigued/drowsy* and *fell asleep*. If a crash report includes either of these, it is referred to the Driver Improvement Medical Review Unit. The driver (even if an out-of-state motorist) is contacted and required to submit a medical statement relating to the cause of the crash certifying that he or she is capable of safely operating a motor vehicle. After review, the driver may be entered into the Medical Review follow-up program as a condition of continued licensure. A driver may also be referred to the Medical Review Unit based on a physician or police report, or a report filed by a family member or another citizen. Board certified neurologists work with the Unit staff to review documentation and assist with determinations.

Drowsy Driving Partnership

The New York State Partnership Against Drowsy Driving (NYPDD), which was established in 2003 and facilitated by the New York State Department of Health (NYSDOH), is a joint effort to educate the public and high-risk populations about the dangers of fatigued and drowsy driving and promote the adoption of preventive strategies. NYPDD includes representatives from AAA Hudson Valley; New York Association for Pupil Transportation; and the New York State Association of Chiefs of Police (NYSCOPA), Traffic Safety Boards, Department of Motor Vehicles, Department of Transportation, Governor's Traffic Safety Committee (GTSC), Thruway Authority, Motor Truck Association (MTA), Police (NYSP) and Sheriffs' Associations (NYSSA). The partners meet regularly to share drowsy driving data and work cooperatively to conduct public awareness projects.

NYPDD *Stay Awake. Stay Alive.* press event

The NYPDD conducts awareness activities in conjunction with Drowsy Driving Prevention Week in November and Sleep Awareness Week in March (coordinated with daylight savings time). In addition to issuing a joint press release calling attention to the danger of driving drowsy, partners use their respective communication channels to educate the public. For example, *Stay Awake. Stay Alive*. reminders are displayed on variable message signs on the 570-mile NYS Thruway and I-87 Northway. Information is included in the NYSDOH monthly injury prevention newsletter, which is distributed to approximately 500 public health and traffic safety partners, and the MTA's *Friday Final* publication that is disseminated to its 800 members. In addition, a new brochure that points out *drowsy driving can be just as deadly as drunk, drugged or distracted driving* is in production and will be available in the summer of 2016.

The partners hold press events at Thruway rest areas, convenience stores, schools, hospitals, and other high traffic locations to call attention to the problem. Traffic safety, transportation, public health, and business leaders have discussed the extent of the problem and appropriate countermeasures, while victim advocates share their stories to put a face to the issue. Motorists can enjoy a free cup of coffee courtesy of rest area vendors and learn about the latest in-vehicle technologies helping to address drowsy driving (provided by the New York State Automobile Dealers Association) while they take a break from the road.

Driver Education

The symptoms of fatigued and drowsy driving, who is most at risk, and effective countermeasures are addressed in the state's driver manual. To help novice drivers prepare for the written exam, interactive practice quizzes for each chapter of the driver manual are available online. The defensive driving section addresses drowsy driving, and the accompanying quiz includes a drowsy driving question.

The state is engaged in a multi-year project to develop a standardized driver education curriculum that is relevant, engaging and developmentally appropriate for teen drivers (NYSDOH, 2016). Dubbed DERIC (Driver Education Research & Innovation Center Project), it is a collaborative initiative between the NYS Departments of Health, Motor Vehicles, and Education; GTSC; NYSP; NYSSA; NYSCOPA; the Office of Alcoholism and Substance Abuse Services; and Health Research, Inc. The curriculum will consist of eleven modules, developed with guidance from expert stakeholders. Drowsy driving is one of a number of issues addressed in the *Physical and Mental Health Effects on Driving* module, which is scheduled for completion in September 2016 and roll-out (following pilot testing) in the spring of 2018. The module calls for students to engage in several drowsy-driving related activities such as tracking their sleep to learn how different amounts impact their bodies and driving behaviors. The *Myth v. Fact* activity prompts students to identify and determine the effectiveness of drowsy driving prevention strategies.

Faculty from the Center for Community Engagement and Leadership Development (CCE) at New York-based Stony Brook University's School of Health Technology and Management responded to a public health issue brought up by high school students enrolled in a summer Health Career Opportunity Program (HCOP) program. A team recruited out of the CCE developed an interactive healthy lifestyles curriculum targeting distracted and drowsy driving among high school students. Launched in 2014, it has been piloted at four, high-need Suffolk County (Long Island) high schools. Students complete activities at four stations – distracted driving, distracted walking, drowsy driving, and speak up – over a three-day period. At the drowsy driving station, students learn about the effects of sleep deprivation on physical and cognitive function, the dangers of drowsy driving and healthy sleep guidelines. They complete an individual sleepiness questionnaire, view a short video portraying the effects of drowsy driving, engage in group discussion and reflection, and play a drowsy driving game. At the Speak Up station, teens

For more information about the Distracted Driving Program:

Carlos M. Vidal, Ph.D.
Associate Dean, School of Health Technology & Management
Stony Brook University
631-444-3153
Carlos.vidal@stonybrook.edu

learn assertiveness skills and practice speaking up when they are in a vehicle with a distracted or drowsy driver. Since inception, the program has served approximately 2,850 students and the participating school districts are motivated to continue to offer it.

Pre- and post-surveys designed to understand high school students' driving and sleep habits, their likelihood of speaking up when they are riding in a car driven by a distracted driver, and their level of satisfaction with the curriculum, were administered to participants during the 2015 implementation. Most of the students were between 16 and 18 years of age and held a permit, restricted or full license. Some students reported driving seven or more hours per week including nighttime driving. A large percentage of students said the program increased their interest in the safety issues addressed by the curriculum and their understanding and awareness of distracted and drowsy driving. The majority of teens said they were exposed to new information and would recommend the program to their peers (Linden, et al. 2016, in review). The results of the survey research will be published in a peer reviewed journal later this year.

The program team, which is composed of University faculty as well as undergraduate and graduate students, would like to see the curriculum incorporated into health and physical education programs at high schools not only on Long Island and in New York City, but also statewide. A train-the-trainer workshop has been developed for high school teachers. The team is also discussing curriculum implementation with representatives of the Native American Unkechaug Sovereign Nation.

Later School Start Time

Glens Falls High School (GFHS) changed the start of its school day from 7:45 a.m. to 8:26 a.m. in the fall of 2012. (The same start time as the middle school.) Three years later, "it's like it has always been this way," said the assistant principal. But the change did not come easy; it required a well thought-out and administratively supported plan that never wavered from its student-centered focus.

Glens Falls is located 200 miles directly north of New York City, along the Hudson River in the foothills of the Adirondack Mountains, and is home to 14,700 residents. The high school serves 650 students, who either walk or are driven/drive to school (transportation is provided for athletics and special needs students only). Despite busing not being an issue, the community was concerned about the impact a later start time would have on traffic (the city is only 3.9 square miles). The school district conducted a traffic study with the city that resulted in the creation of drop-off zones that have improved traffic flow.

Not surprisingly, concerns were raised about the later start time's impact on extra-curricular activities. "Once the school board approved the new start time," said the assistant principal, "the superintendent issued a directive that the athletic schedule shouldn't negatively impact academics resulting in athletes missing important class time. That involved adjusting the athletic schedule so games started 30 to 45 minutes later."

NPR Segment Addresses Benefits of Later Start Time at GFHS

KCRW, the National Public Radio affiliate in Southern California, interviewed Glens Falls High School Assistant Principal Liz Collins and Kyla Wahlstrom, Director of the Center for Applied Research and Education Improvement and a noted later school start time expert. Listen to the 11-minute segment.

HIGH SCHOOL START TIME *news from* Glens Falls CITY SCHOOLS

Dear Parents and Guardians:

As you know, the High School's daily schedule is being restructured to run the current nine periods of instructional time beginning at approximately 8:30 a.m. instead of 7:45 a.m. and ending at 3:00 p.m. instead of 2:22 p.m. This change will take effect in September.

The shift is being made to allow students approximately 45 extra minutes of sleep in the early morning, which will increase student performance, elevate the overall health of our students, and ultimately improve the learning process.

Change is a challenge for everyone, and it takes time to adjust. Some of the resources below may be useful to parents and guardians as they prepare their families for the start time change.

We thank you in advance for your cooperation as we move forward in implementing the later start time at the High School. We're confident that our students, parents and staff members can work together to "provide a safe, positive and stimulating environment — one that fosters self-growth, a passion for continuous learning, confidence and the ability to succeed in a changing world."

additional Resources

The National Sleep Foundation
www.sleepfoundation.org
Find facts on adolescent sleep needs and patterns, and get advice on how to maximize the value of your sleep from this nonprofit organization dedicated to alerting the public to the importance of adequate sleep.

School Start Time.org
http://schoolstarttime.org
Read a wide sampling of annotated sleep research from the scientific community and case studies from school districts that have instituted a later start time.

American Psychological Association
www.apa.org
Read the October 2001 cover story from the APA's professional journal, *Monitor on Psychology:* "Sleep deprivation may be undermining teen health."

Glens Falls City School District
www.gfsd.org
Check the High School's home page on the district web site for links to the School Start Time Committee's research, analysis and recommendations.

Did you know?
Quick facts about teens and sleep

- Studies have proven that adolescents have trouble staying awake in early-morning classes because of their biological clocks, not lethargy, "laziness," or lack of parental discretion *(Lawton 2005)*.
- Poor sleepers are more likely to fail a grade than other students are, even when they do a similar amount of homework *(Kahn, et al. 1989)*.
- Research has shown that sleep deprivation in teens can lead to irritability and impulsiveness *(Bates, et al. 2002)*; depression and lower self-esteem *(Fredriksen, et al. 2004)*; and decreased functionality, even though the teenager may not report feeling sleepy *(Beatty, 2001; Horowitz, et al. 2003)*.
- Adolescents require at least as much sleep as they did when they were children, generally 8 1/2 to 9 1/4 hours each night *(Carskadon et al. 1980)*.
- A 2006 poll conducted by the National Sleep Foundation on 1,600 adolescents nationwide found that more than half (56%) of teenagers report getting less sleep than they need to feel rested during the school week.
- A large-scale longitudinal study of schools that changed their start times showed that for all six grade levels (7-12), there was a significant increase in reported academic grades with progressively later start times *(School Start Time Study, 2000)*.
- A 2011 report from the Brookings Institute recommended starting school later in the day for middle and high school students as an organizational reform with the greatest potential to increase student performance at modest costs.

www.gfsd.org

1

While these and other obstacles have derailed similar efforts in other school districts, the assistant principal said involving the entire community in the process and keeping them informed every step of the way were the keys to success. The district launched the effort with a parent/student information night that featured Dr. Helene Emsellem, a clinical professor of neurology and author of *Snooze or Lose! 10 No-War Ways to Improve Your Teen's Sleep Habits.* It followed that up with three surveys (for parents, students, and teachers) to gauge their knowledge and support. When students engaged in a peaceful strike outside a board of education meeting, the administration met with the students to address their questions and concerns

But most importantly, once the later start time was approved, the District published nine editions of the *High School Start Time News* to help families acclimate to the change. The one-page *News* included resources to help parents learn more about teens and sleep and the latter's impact on their health and well-being, including school performance. The District also worked with a St. Lawrence University researcher to conduct a study of

the later start time's impact on GFHS students' sleep, which included teens keeping a sleep diary (families could opt out). That entire effort, including preliminary and final results, was chronicled in the *News*. The final edition carried the headline, *Later start, better grades*.

The change, according to independent researchers and school officials, has been positive. GFHS students reported getting as much as 12 to 48 more minutes of sleep per night, which researchers concurred is beneficial and in line with previous study findings. "The number [of GFHS] students who are tardy to school has also decreased, the percentage of failures has dropped… [and] teachers are reporting that students are more alert in their AM classes," said the assistant principal (KCRW/National Public Radio, 2014).

She admitted that sleep and its impact on teen driving was not part of the discussion when the District first started talking about changing the start time, but now recognizes that it is an important factor that schools should consider. Since driver education is no longer taught at GFHS, sleep has been brought to the forefront in health classes. The administration also partners with the SHSO to bring safe driving presentations to the high school.

Law Enforcement Training

The *Commercial Vehicle Awareness Training* for Law Enforcement sponsored by the Governor's Traffic Safety Committee (GTSC) will be updated to include information about fatigue and drowsy driving. Officers will be trained to be on the lookout for large trucks and buses that are being driven erratically indicating signs of distraction, alcohol or drug impairment, and/or drowsy driving and to make the stop. If during the traffic stop and interview of the vehicle's operator signs of fatigued or drowsy driving exist, officers will be instructed to advise the operator not to continue to drive the vehicle, and if necessary to contact a certified commercial motor vehicle officer to take further appropriate action.

Officers will be trained to be on the lookout for large trucks and buses that are being driven erratically indicating signs of distraction, alcohol or drug impairment, and/or drowsy driving and to make the stop.

Officers also receive training in proper completion of the crash reporting form (MV-104A & 104S - Truck & Bus Supplemental Police Accident Report) to ensure that the appropriate fields are completed to accurately capture the human factors (e.g., fatigued/drowsy, fell asleep) that contributed to the crash. GTSC has also updated its awareness and educational pamphlet, *Commercial Drivers Avoid the 4D's*, that will be incorporated into the training materials provided to officers.

Conclusion

Drowsy driving is not a new traffic safety problem. As long as people have been driving, they have also had the potential to get behind the wheel without sufficient sleep. The recognition of drowsy driving as a significant public health and traffic safety issue is, however, a new and welcome development. The onus is now on these two sectors not only to keep it front and center, but also to engage the public in recognizing the seriousness of the problem and take the necessary steps to prevent it. This is a daunting task, made even more difficult by the fact that:

- **The true extent of the problem is hampered by incomplete data.**
- **There is no one universally accepted definition or subjective or objective tool to determine if a motorist is too tired to drive.**
- **Drowsy driving is not viewed as socially unacceptable.**
- **The public does not understand the importance of sleep and how much they need to drive safely.**

The good news is that NHTSA has developed a plan to tackle these and other challenges and is working with many organizations to bring it to fruition. As that work progresses, SHSOs and their partners must also join in. Change will not happen overnight; just like drunk driving and seat belt use, it will take time to change the culture. The first step is to carefully consider what has been outlined in this report and identify those countermeasures that present the best opportunity to effect change in your respective state and/or community. Next, you will need help – and lots of it. Lack of sleep is not just a traffic safety problem, but one that impacts our health and well-being as well as academic and on-the-job performance. That means that all sectors – public, private, business, academia, nonprofit – have a stake in the game. Some are already engaged, others need to be educated, but all will benefit from participating in the dialogue and investing in the solution.

Change will not happen overnight; just like drunk driving and seat belt use, it will take time to change the culture. The first step is to carefully consider what has been outlined in this report and identify those countermeasures that present the best opportunity to effect change in your respective state and/or community.

References

AAA Foundation for Traffic Safety. (2004). Survey of U.S. and Canadian police officers about the public's drowsy driving behavior. Washington, DC. Retrieved from https://www.aaafoundation.org/sites/ default/files/PoliceDD.pdf

AAA Foundation for Traffic Safety. (2014). Vehicle safety technology ratings matrix [Website]. Washington, DC. Retrieved from http://www.aaafoundation.org/vehicle-safety-technology-ratings-matrix

American Automobile Association. (2016). Sleepiness and driving don't mix [Web page]. AAA Exchange. Heathrow, FL. Retrieved from http://exchange.aaa.com/safety/roadway-safety/drowsy-driving/#. Vze RH2fruUl

American Academy of Sleep Medicine. (2015a). Template drowsy driving language for state driving manuals, curriculum, and exam questions. Darien, IL.

American Academy of Sleep Medicine (2015b). Healthy sleep project urges parents to teach teens to avoid drowsy driving [Press release]. Darien, IL. Retrieved from http://www.aasmnet.org/articles. aspx?id-5474

American Academy of Pediatrics. (2014a). School start times for adolescents. *Pediatrics*. Elk Grove, IL: Adolescent Sleep Working Group and Committee on Adolescence, and Council on School Health. doi:10.1542/peds.2014-1697.

American Academy of Pediatrics. (2014b). Let them sleep: AAP recommends delaying start times of middle and high schools to combat teen sleep deprivation [Web article]. Elk Grove, IL. Retrieved from https://www.aap.org/en-us/about-the-aap/aap-press-room/pages/Let-Them-Sleep-AAP-REcommends-Delaying-Start-Times-of-Middle-and-High-Schools-to-Combat-Teen-Sleep-Deprivation.aspx

American Driver and Traffic Safety Education Association. (2011). Free 3.0 curriculum. Retrieved from http://www.adtsea.org/30%20Curriculum%20PDF's/002%20-%20Preface.pdf

Arkansas General Assembly. (2013). Senate Bill 847, An act to amend the offense of negligent homicide; and for other purposes. Little Rock, AR.

Arnedt, T., Wilde, G., Munt, P., & MacLean, A. (2001). How do prolonged wakefulness and alcohol compare in the decrements they produce on a simulated driving task? *Accident Analysis & Prevention*, 33, 337-344.

Arnold, L.S., & Tefft, B. C. (2015). Prevalence of self-reported drowsy driving, United States: 2015. Washington, DC: AAA Foundation for Traffic Safety. Retrieved from http://www.aaafoundation.org/ sites/default /files/ prevalenceofself-reportedDrowsyDrivingReport.pdf

Barger, L. K., Cade, B. E., Ayas, N. T., Cronin, J. W., Rosner, B. L., Speizer, F. E., & Czeisler, C. A. (2005). Extended work shifts and the risk of motor vehicle crashes among interns. *New England Journal of Medicine*, 13:352(2): 125-34. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15647575/

Belvedere, M. J. (2016, April 5). Why Aetna's CEO pays workers up to $500 to sleep [Web article]. CNBC. Retrieved from http://www.cnbc.com/2016/04/05/why-aetnas-ceo-pays-workers-up-to-500-to-sleep.html

Blum, A. B., Shea, S., Czeisler, C. A., Landrigan, C. P., & Leape, L. (2011). Implementing the 2009 Institute of Medicine recommendations on resident physician work hours, supervision, and safety. *National Science Sleep*, 3:47-85. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3630963/

Browning, P. (2015, Sept 16). Smartphones vs. sleep: CSUDH psychology professors' study takes a look [Web press release]. Carston, CA: California State University, Dominguez Hills. Retrieved from http:// www.csudhnews.com/2015/09/rosen-sleep/

California Commission on Peace Officer Standards and Training. (2016). SAFE Driving Campaign [Web page]. West Sacramento, CA. Retrieved from https://www.post.ca.gov/safedriving.aspx

Carlson, M. (2016, March 22). After crash filled year, device could soon make Iowa's interstates safer. KCRG-TV9. Iowa City, IA. Retrieved from http://www.kcrg.com/content/news/After-Crash-Filled-Year-Device-Could-Soon-Make-Iowas-Interstates-Safer-373158321.html

Caruso C. C., Geiger-Brown, J., Takahashi, M., Trinkoff, A., & Nakata, A. (2015). NIOSH training for nurses on shift work and long work hours. [Publication No. 2015-115]. Cincinnati, OH: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Retrieved from http://www.cdc.gov/niosh/docs/2015-115/

Center for College Sleep/St. Thomas University. (2014). Why sleep matters, facts about college student sleep [Web page]. St. Paul, MN. Retrieved from http://www.stthomas.edu/collegesleep/whysleep matters/

Center for College Sleep/St. Thomas University/Macalester College. (2016a). How sleep friendly is your campus [Flyer]. St. Paul, MN.

Center for College Sleep/St. Thomas University/Macalester College. (2016b). College sleep environmental scan [Web pages]. St. Paul, MN. Retrieved from http://www.stthomas.edu/collegesleep/ collegesleepquestionnaire/

Centers for Disease Control and Prevention. (2013). Benefits of health promotion programs [Web page]. Atlanta, GA: Division of Population Health/Workplace Health Promotion. Retrieved from http://www. cdc.gov/workplacehealthpromotion/businesscase/benefits/

Che, J. (2016, March 7). Why more bosses need to embrace napping at work [Web article]. The Huffington Post. Retrieved from http://www.huffingtonpost.com/entry/napping-at-work_us_ 56ddbd65e4b0000 de4054a0c

Colvin, L. J., & Collop, N. A. (2016). Commercial motor vehicle driver obstructive sleep apnea screening and treatment in the United States: An update and recommendation overview. *Journal of Clinical Sleep Medicine, 12*(1): 113-125.

Commercial Vehicle Safety Alliance. (2014, Oct. 10). Petition to amend 49 CFR Part 392 to enhance compliance and enforcement of commercial driver fatigue, Testimony before the United States Department of Transportation Federal Motor Carrier Safety Administration. Greenbelt, MD.

Czeisler, C. A., & Baldino, F. (2015). Drowsy driving overview: Data, measurement & contributing factors [PowerPoint]. 2015 National Sleep Foundation Sleep Health & Safety Conference. Arlington, VA.

Czeisler, C.A., Lee, M. L., Howard, M. E., Horrey, W. J., Liang, Y., Anderson, C., Shreeve, M.S., & O'Brien, C. S., (2015, December). High risk of near-crash driving events following night-shift work. *PNAS*. Retrieved from http://www.pnas.org/content/113/1/176

Danner, F., & Phillips, B. (2008). Adolescent sleep, school start times, and teen motor vehicle crashes. *Journal of Clinical Sleep Medicine*, 4(6).

Davidson, L. (2016, January 1). New Utah drivers to face extra written test. *The Salt Lake Tribune*. Retrieved from http://www.sltrib.com/csp/mediapool/sites/sltrib/pages/printfriendly.csp?id=3365929

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388, 235.

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *PNSA*. Retrieved from http://www.pnas.org/cgi/doi/10.1073/pnsa.1513271113

Doheny, K. (2015, Dec. 15). Drowsy driving: How to help your teen driver avoid it, Young drivers are especially vulnerable to falling asleep at the wheel. Here's how parents can help [Web article], SafeBee from UL. Retrieved from http://www.safebee.com/travel/drowsy-driving-how-help-teen-driver-avoid

Emergency Medical Services/National Highway Traffic Safety Administration. (2016). Fighting fatigue in EMS [Web article]. Washington, DC: EMS/NHTSA. Retrieved from http://www.ems.gov/newsletter/ marapr2016/fighting-fatigue-in-ems.html

Federal Highway Administration. (2015). Safety, cable barriers [Web page]. Washington, DC. Retrieved from http://safety.fhwa.dot.gov/roadway_dept/policy_guide/ road_ hardware/ctr measures/cable _barriers/

Federal Motor Carrier Safety Administration. (2015). 2015 pocket guide to large truck and bus statistics [Pamphlet]. Washington, D. C.: U.S. Department of Transportation. Retrieved from https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/2015%20Pocket%20Guide%20-%20March%2030%202015%20%28For%20Web%20Publishing%29-508c_0.pdf

Florida Legislature. (2011). 2011 Florida statutes, Section 332, Ronshay Dugans Act. Tallahessee, FL. Retrieved from http://www.flsenate.gov/Laws/Statutes/2011/683.332.

Geiger-Brown, J., & Lipscomb, J. (2010). The health care work environment and adverse health and safety consequences for nurses. *Annual Review of Nursing Research*, 28; 191-231.

Governors Highway Safety Association. (2015). GHSA drowsy driving concerns [Position statement]. Washington, DC.

Hartmann, J., & Prichard, J. R. (2014). Sleepless in school: Professors examine the price we pay for poor sleep. St. Paul, MN: University of St. Thomas. Retrieved from http://www.stthomas.edu/news/sleepless-school-professors-examine-price-pay-poor-sleep/

Hersmann, D. (2016). You're more than tired, you're deadly [Blog post]. Huffington Post. Retrieved from http://www.huffingtonpost.com/deborah-hersman/youre-more-than-tired-you_b_9644102.html

Holohan, M. (2014, Nov. 9). Why can't we sleep? TODAY 'snooze or lose' survey results may surprise you. [Web article]. Retrieved from http://www.today.com/health/why-cant-we-sleep-today-snooze-or-lose-survey-may-1D80274530

Hughes, S. (2015, June 30). New recommendations to achieve healthy sleep. *Medscape*. Retrieved from http://www.medscape.com/viewarticle/847220_print

Iowa State Patrol. (2016). Drowsy driving [PowerPoint]. Cedar Rapids, IA.

James, S. M., & Vila, B. (2015). Police drowsy driving: Predicting fatigue-related performance decay. *Policing: An International Journal of Police Strategies & Management*, 38(3): 517-538. doi:10.1108/ PIJPSM-03-2016-0033

Keppler, S. A. (2011). Saving lives by citing truck and bus violations, Highway safety initiatives. *The Police Chief,* 78:82. Retrieved from http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction= display_arch&article_id=2540&issue_id=112011

Klauer, S. G., Dingus, T. A., Neale, V. L., Sudweeks, J. D., & Ramsey, D. J. (2006). The impact of driver inattention on near-crash/crash risk: An Analysis using the 100-car naturalistic driving study data [DOT HS 810 594]. Washington, DC: National Highway Traffic Safety Administration.

KCRW/National Public Radio. (2014, April 3). Press play: High schools push back start bell to let teenage students sleep [Radio broadcast]. Los Angeles, CA. Retrieved from https://soundcloud.com/kcrw/high-schools-push-back-start

Lerman, S. E., Eskin, E., Flower, D. J., George, E. C., Gerson, B., Hartenbaum, N., Hursh, S. R., & Moore-Ede, M. (2012). ACOEM guidance statement, Fatigue risk management in the workplace. *Journal of Occupational and Environmental Medicine, 54*(2):231-258. DOI:10.1098/JOM.0b013e318247a3b0

Linden, P., Endee, L., Flynn, E., Johnson, L., Miller, CA., Rozensky, R., Smith, S., & Verderosa, C. (2016). *Outcomes of a prevention of distracted driving program for high school students in high-needs school districts*. Stony Brook, NY: Center for Community Engagement & Leadership Development, Stony Brook University School of Health Technology and Management.

Liu, Y., Wheaton, A. G., Chapman, D. P., Cunningham, T. J., Lu, H., & Croft, J. B. (2016). Prevalence of healthy sleep duration among adults – United States, 2014. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/mmwr/volumes/65/wr/mm6506a1. htm?s_cid=mm 6506a1_w

Martinez, M. (2016, March 16). Sources: Carmakers agree to automatic braking by 2020 [Web article]. *Detroit News*. Retrieved from http://detroitnews.com/story/business/autos/2016/03/16/automakers-pledge-standard-braking/81864662/

Maryland Department of Health and Mental Hygiene. (2014). Study of safe and healthy school hours for Maryland Public Schools [Report]. Baltimore, MD.

Maryland Legislature. (2016). House bill 39, Education – Orange ribbon for healthy school hours – Establishment. Annapolis, MD.

Massachusetts Department of Transportation. (2014). Driver education program [Curriculum]. Boston, MA: Massachusetts Registry of Motor Vehicles. Retrieved from http://www.massrmv.com/mv/jol/ DriverEducationProgram.pdf

Traffic Injury Prevention, Miller, C. M. (2008). Lack of training in sleep and sleep disorders [Virtual mentor]. *AMA Journal of Ethics*, *10*(9): 560-563. Retrieved from http://journalofethics.ama-assn.org/2008/090/medu1-0809.html

Minnesota Department of Transportation. (2016). Cable median barriers, How they work [Web page]. St. Paul, MN. Retrieved from http://www.dot.state.mn.us/trafficeng/reports/cmbarrier.html

National Center for Statistics and Analysis. (2011, March). Traffic safety fact crash stats: Drowsy driving. (DOT HS 811 449). Washington, DC: National Highway Traffic Safety Administration. Retrieved from http://www-nrd.nhtsa.dot.gov/pubs/811449.pdf

National Conference of State Legislatures. (2015). Summaries of current drowsy driving laws [Web article]. Denver, CO. Retrieved from http://www.ncsl.org/research/transportation/summaries-of-current-drowsy-driving-laws.aspx

National Highway Traffic Safety Administration. (1998). Drowsy driving and automobile crashes, NCSDR/NHTSA expert panel on driver fatigue and sleepiness. Washington, DC. Retrieved from http://www.nhtsa.gov/people/injury/drowsy_driving1/Drowsy.html

National Highway Traffic Safety Administration. (2016, March). NHTSA drowsy driving research and program plan [DOT HS 812 252). Washington, DC.

National Institute of Justice. (2012). Preventing officer fatigue [Web article]. Washington, DC: U.S. Department of Justice, Office of Justice Programs. Retrieved from http://www.nij.gov/topics/law-enforcement/officer-safety/stress-fatigue/Pages/preventing.aspx

National Safety Council. (2016). MyCarDoesWhat.org, Know more. Drive safer [Website]. Itasca, IL. Retrieved from https://mycardoeswhat.org/

National Sleep Foundation. (2015a). 2015 Sleep in America®poll, sleep and pain, summary of findings. Arlington, VA. Retrieved from http://www.sleephealthjournal.org/pb/assests/raw/Health%20Advance /journals/sleh/2015/sleepinAmericaPollSummaryofFindings.pdf

National Sleep Foundation. (2015b). State of the states – Drowsy driving. Arlington, VA. Retrieved from http://sleepfoundation.org/sites/default/files/4-state%10of%20%the%20states%20Chart-9.5.2014-final.pdf

National Sleep Foundation. (2015c). Expert panel concludes that two hours of sleep is not enough for drivers [Press release]. Arlington, VA.

National Transportation Safety Board. (1994). Aircraft accident report, Uncontrolled collision with terrain American International Airways flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay, Cuba, August, 18, 1993. Washington, DC. Retrieved from http://libraryonline. erau.doc/online-full-text/ntsb/aircraaft-accident-reports/AAR94-04.pdf

National Transportation Safety Board. (2016). Reduce fatigue-related accidents. What is the issue? [Web page]. Washington, DC. Retrieved from http://www.ntsb.gov/safety/mwl/Pages/mw11-2016.aspx

Network of Employers for Traffic Safety. (2014). NETS' comprehensive guide to road safety™. Vienna, VA. Retrieved from http://trafficsafety.org/wp-content/uploads/2015/06/NETS-Comprehensive-Guide-To-Road-Safety-English.4.pdf

Network of Employers for Traffic Safety. (2015). DSWW 2015 materials available [Web page]. Vienna, VA. Retrieved from http://trafficsafety.org/dsww-2015-materials-now-available

Network of Employers for Traffic Safety. (2016). Cost of motor vehicle crashes to employers – 2015™. Vienna, VA. Retrieved from http://www.trafficsafety.org

New Jersey Legislature. (2002). Assembly bill 1347, State of New Jersey. Trenton, NJ. Retrieved from http://www.njleg.state.nj.us/2002/Bills/A1500/1347_R2.HTM

New York State Department of Health. (2007). New baby? Less sleep? Important facts about drowsy driving for parents. Albany, NY. Retrieved from https://www.health.ny.gov/publications/3100.pdf

Peck, E. (2016, January 21). JPMorgan tells some bankers to stop working weekends – unless they have to [Web article]. The Huffington Post. Retrieved from http://www.huffingtonpost.com/entry/jpmorgan-chase-weekends_us_56a0391fe4b040eb8f05b44

Rajaratnam, S. W., Barger L. K., Lockley S. W., Shea, S. A., Wang, W., Landrigan, C. P., O'Brien, C. S., Qadri, S., Sullivan, J. P., Cade, B. E., Epstein, L. J., White, D. P., & Czeisler, C. A. (2011). Sleep disorders, health, and safety in police officers. *JAMA.* 306(23): 2567-2578. Retrieved from http://jama. jama network.com/ article.aspx?articleid=1104746

Rajaratnam, S. W., Landrigan, C. P., Wang, W., Kaprielian, R., Moore, R. T., & Czeisler C. A. (2015). Teen crashes declined after Massachusetts raised penalities for graduated driver licensing law restricting night driving. *Health Affairs, 34*(6): 963-970. doi:10.1377/hlthaff.2014.0928

Ranji, S. R., & Wachter, R. M. (2013). Chapter 43, Limiting individual providers' hours of service: Brief update review. In *Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices.* Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from http://www .ncbi.nlm.nih.gov/books/NBK133396/

Ray, M. H. (2007) Independent expert report, *An Evaluation of WSDOT's Cable Median Barrier Policy*. Olympia, WA: Washington State Department of Transportation. Retrieved from http://www.wsdot. wa.gov/publications/fulltext/cablemedianbarrier/04_Chap1_Reduced.pdf

Roadway Safety Foundation. (2016). RSF materials [Web page]. Washington, DC. Retrieved from http://www.roadsafety.org/rsf-materials/

Rosekind, M. (2012). Fatigue: A motor vehicle crash risk. 5th Annual Association for the Advancement of Automotive Medicine Conference, October, Seattle, WA.

Rosekind, M. (2014, March). Drowsy driving [Podcast]. Washington, DC: National Transportation Safety Board. Retrieved from http://highwaytosafety.com/drowsy-driving/

Rosekind, M. (2015, March). Remarks: 2015 Lifesavers National Conference on Highway Safety Priorities. Washington, DC: National Highway Traffic Safety Administration. Retrieved from http://www.nhtsa.gov/About+NHTSA/Speeches,+Press+Events+&+Testimonials/remarks-mr-lifesavers-03162015

Schneider. (2016). Schneider safety leader earns top accolades from prestigious National Safety Council [Press Release]. Green Bay, WI. Retrieved from https://www.schneider.com/KnowledgeHub/News/ PRD_006603

Schultz, G. G., & Young, H. T., (2007). A safety analysis of fatigue and drowsy driving in the State of Utah [Report No. UT-07.07]. Salt Lake City: Utah Department of Transportation.

Scott, L. D., Hwang, W. T., Rogers, A. E., Nysse, T., Dean, G. E., & Dinges, D. F. (2007). The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep, 30*(12), 1801-1807.

Stimpfel, A. W., & Aiken, L. H. (2012). Hospital staff nurses' shift length associated with safety and quality of care. *Journal of Nursing Care Quality*. Retrieved from http://www.nursing.upenn.edu/chopr/ documents/witkoskihospitalstaff.pdf

St. Thomas University. (2015). Wellness Center sleep challenge has meaningful results [Press release]. St. Paul, MN. Retrieved from http://www.stthomas.edu/news/wellness-center-sleep-challenge-meaningful-results

Tarkan, L. (2015, April 15). How to help your teen get enough sleep, Too much homework, extracurricular activities and social media at night? Here's how to help your child get the sleep he needs [Web article]. SafeBee from UL. Retrieved from http://www.safebee.com/family/how-to-help-teen-get-enough-sleep

Tarokhn, L. & Carskadon, M.A. (2009). Sleep in adolescents. In Squire, L. R. (Ed). *Encyclopedia of Neuroscience*, 8: 1015-1022. Oxford, England: Academic Press.

Tefft, B. C. (2014). Prevalence of motor vehicle crashes involving drowsy drivers, United States: 2009-2013. Washington, DC: AAA Foundation for Traffic Safety. Retrieved from https://www.aaafoundation. org/sites/default/files/AAAFoundation-DrowsyDriving-Nov2014.pdf

The Children's National Medical Center. (2014). School start time change: An in-depth examination of school districts in the United States. Washington, DC: Blueprint for Change Team http://www.fcps.edu /supt/update/1415/Blueprint-Change-School-Start-Time-Change-ReportFinal4-14-14.pdf

The National Academy of Sciences, Engineering and Medicine. (2016). Research needs on CMV driver fatigue, long-term health, and highway safety. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. doi: 10.17266/ 21921.

Truck Safety Coalition. (2016). About PATT [Web page]. Arlington, VA. Retrieved from http://trucksafety. org/about-truck-safety-coalition/about-patt/

Toyota U.S. Motor Sales. (2016, March 21). Lexus and Toyota will make automated braking standard on nearly every model and trim level by end of 2017 [Press release]. Toyota News Room. Retrieved from http://pressroom.toyota.com/releases/lexus+toyota+automated+breaking+standard+2017.htm

UCLA Sleep Disorder Center. (2016). Sleep and teens [Web page]. Los Angeles, CA: Center for Health Sciences. Retrieved from http://sleepcenter.ucla.edu/body.cfm?id=63

University of Arkansas Medical School. (2016). Call system – Internal medicine [Web page]. Little Rock, AR. Retrieved from http://intmedicine.uams.edu/residency/im/training/call/

University of Iowa. (2015). DMV traffic safety survey 2015. Des Moines, IA: Governor's Traffic Safety Bureau.

U.S. Department of Health and Human Services. (2010). HHS announces the nation's new health and disease prevention agenda [Press release]. Washington, DC. Retrieved from http://www.hhs.gov/news

U.S. Department of Health and Human Services/National Institutes of Health. (2011). Your guide to healthy sleep. [NIH Publication No. 11-5271]. Bethesda, MD: National Heart Lung and Blood Institute.

U.S. Department of Health and Human Services. (2016). Sleep health [Web page]. Washington, DC. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/sleep-health/objectives

U.S. Federal Register. Docket 98-3542. (2000). Physical qualification of drivers; medical examination; certificate. Washington, DC: U.S. Department of Transportation, Federal Motor Carrier Safety Administration. Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2000-10-05/html/00-25337.htm

Utah Department of Public Safety. (2016). Parents guide to smart teen driving. Salt Lake City, UT. Retrieved from http://www.dontdrivestupid.com/wp-content/themes/DDS_Packery/downloads.php? download=parent-guide-to-smart-teen-driving

Utah Department of Transportation. (2016). Utah strategic highway safety plan, Version 4.0. Salt Lake City, UT. Retrieved from http://ut.zerofatalities.com/mainsite/wp-content/uploads/2016/04/SHSP_Version_4.pdf

Utah Highway Safety Office. (2016). Utah highway safety plan. Salt Lake City: Utah Department of Public Safety. Retrieved from http://highwaysafety.utah.gov/wp-content/uploads/sites/22/2016/01/2016-HSP.pdf

Valdes-Dapena, P. (2016). Volvo promises deathproof cars by 2020 [Web page]. CNN Money. Retrieved from http://money.cnn.com/2016/01/20/luxury/volvo-no-deaths-crash-cars-2020/index.html?source= linkedin

Vila, B. (2000). Tired cops: The importance of managing police fatigue. Washington, D.C.: Police Executive Research Forum.

Vila, B. (2011). The effects of officer fatigue on accountability and the exercise of police discretion. In Candace McCoy [ed.], *Holding Police Accountable*, Chapter 7. Washington, D.C.: Urban Institute Press.

Vila, B., & Kenney, D. J. (2002). Tired cops: The prevalence and potential consequences of police fatigue. *National Institute of Justice Journal*, 248: 16-21.

Virginia Tech Transportation Institute. (2016). Insight data access website, SHRP2 naturalistic driving study. Retrieved from https://insight.shrp2nds.us/

Wahlstrom, K. L. (2013). Later school start times [PowerPoint presentation]. Teens & Sleep National Conference, October 3-4, 2013. Minneapolis, MN: Center for Applied Research and Education Improvement in the College of Education and Human Development, University of Minnesota. Retrieved from http://www.cedhumn.edu/carei/REsources/Sleep/default.html

Wahlstrom, K. L., Dretzke, B. J., Gordon, M. F., Peterson, K., Edwards, K., & Gdula, J. (2014). Examining the impact of later high school start times on the health and academic performance of high school students: A multi-site study [Final Report]. Minneapolis, MN: Center for Applied Research and Education Improvement in the College of Education and Human Development, University of Minnesota. Retrieved from http://conservancy.umn.edu/handle/11299/162769

Walhstrom, K. L. (2015, January). Creative solutions for the 'sleep phase shift,' *School Administrator*.

Wahlstrom, K. L. (2016). Later high school start times: Research findings summary [Handout]. Lifesavers Annual Conference, April 2016. Minneapolis, MN: Center for Applied Research and Educational Improvement, University of Minnesota.

Wheaton, A. G., Ferro, G. A., & Croft, J. B. (2015). School start times for middle school and high school students – United States, 2011-12 school year. Atlanta, GA: Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6430a1. htm?s_cid= mm6430a1_e

Wheaton, A. G., Olsen, E. O., Miller, G. F., & Croft, J. B. (2016). Sleep duration and injury-related risk behaviors among high school students – United States, 2007-2013. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/mmwr/volumes/65/wr/mm6513a1.htm