

# MANAGING

# FATIGUE

## DEVELOPING AN EFFECTIVE FATIGUE RISK MANAGEMENT SYSTEM



# EXECUTIVE SUMMARY



## Managing Fatigue in the Workplace

Fatigue is a fact of life in our always-on, 24/7 world. The pressure of work hours, family obligations and community participation puts stress on employees. People often think the simplest way to carve out more time for life's responsibilities is to cut back on sleep. However, sleep deficit has a profound impact on people's ability to work safely and productively on the job, and to enjoy life in off-the-job hours.

Even in ideal circumstances, fatigue will be an issue for some portion of every organization's workforce. This report defines fatigue and discusses its effects on the workplace, subsequently making recommendations for the implementation of a fatigue risk management system (FRMS). These systems include:

- **Education and training** (p. 8)  
Sleep health programs and sleep disorder screening
- **Policies and practices** (p. 10)  
Shift scheduling and work hour limits
- **Shared responsibility** (p. 13)  
Employers and employees working together to optimize productivity, health and safety
- **Fatigue mitigation** (p. 14)  
Workplace environmental controls and rest opportunities
- **Data-driven programs & continuous improvement** (p. 16)  
Reporting, measuring outcomes and applying key learnings

When an organization embraces fatigue management and mitigation, designating a "fatigue champion" on the safety or executive team will show employees that their management is committed to making them healthier and safer. An FRMS can be integrated with existing safety programs, implemented independently as a whole program or implemented in stages, depending on the systems and staffing available. A transparent FRMS system where honesty about fatigue on employees' part and reasonable expectations on employers' part creates trust and cooperation, and improves productivity, safety and health for employees.





# IMPACT OF FATIGUE

## Impact of fatigue on employees

Fatigue affects everyone at some time. Not getting needed sleep or having the body clock thrown out of rhythm can significantly affect performance, productivity and safety, on and off the job.

## Physical and mental functioning

When people don't get the sleep they need, they aren't able to physically or mentally function at optimal levels.<sup>1,2</sup> Routine tasks feel more demanding. Reaction times slow. People become more forgetful, make poorer decisions, and don't communicate or coordinate well with their co-workers. Find more information about the effects of fatigue on physical and mental functioning in the NSC report *Tired at Work: How Fatigue Affects Our Bodies*.

## Health and quality of life

Over time, getting less sleep than needed can lead to health consequences such as increased risks for obesity<sup>3</sup>, heart disease<sup>4</sup> and high blood pressure.<sup>5</sup> Mood can also be affected and have an impact on relationships with friends and family, affecting overall quality of life.

## Impact on the workplace

Many studies have found a connection between fatigue and increased safety risks on the job in a wide range of work settings.<sup>6</sup> Long work hours, working at night, and rotating shifts are some factors that can lead to increased risks of errors, incidents, accidents and injuries.<sup>7,8,9</sup>

<sup>1</sup>Roth, T. (2007). Insomnia: definition, prevalence, etiology, and consequences. *Journal of Clinical Sleep Medicine*, 3 ( 5 Suppl): S7-10.

<sup>2</sup>Van Dongen, H., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26 (2), 117-126.

<sup>3</sup>Beccuti, G. & Pannain, S. (2011). Sleep and obesity. *Current Opinion in Clinical Nutrition & Metabolic Care*, 14 (4), 402.

<sup>4</sup>Bonnet, M. H. & Arand, D. L. (2007). Cardiovascular implications of poor sleep. *Sleep Medicine Clinics*, 2 (4), 529-538.

<sup>5</sup>Palagini, L., Maria Bruno, R., Gemignani, A., Baglioni, C., Ghiadoni, L., & Riemann, D. (2013). Sleep loss and hypertension: a systematic review. *Current Pharmaceutical Design*, 19 (13), 2409-2419.

<sup>6</sup>Lombardi, D. A., Folkard, S., Willetts, J. L., & Smith, G. S. (2010). Daily sleep, weekly working hours, and risk of work-related injury: U.S. National Health Interview Survey (2004–2008). *Chronobiology International*, 27 (5), 1013-1030.

<sup>7</sup>Smith, C.S., Folkard, D., Tucker, P., Evans, M.S. (2011). Work schedules, health, and safety. In Quick, J.C., Tetrick, L.E., eds. *Handbook of occupational health psychology, second edition*. Washington, DC: American Psychological Association, pp.185-204.

<sup>8</sup>Bourgeois-Bougrine, S., Carbon, P., Gounelle, C., Mollard, R., & Coblentz, A. (2003). Perceived fatigue for short-and long-haul flights: a survey of 739 airline pilots. *Aviation, Space, and Environmental Medicine*, 74 (10), 1072-1077.

<sup>9</sup>Vila, B. (2009). Sleep Deprivation: What Does It Mean for Public Safety Officers? National Institute of Justice. Accessed October 10, 2018 at <https://www.nij.gov/journals/262/pages/sleep-deprivation.aspx>

### Decreased productivity

Absenteeism represents a significant cost to organizations, and sleep loss has been identified as one of its leading causes. Presenteeism, being at work but not working effectively, also leads to significant reductions in productivity. With reduced physical and mental functioning due to lost sleep, productivity goes down.<sup>10, 11, 12</sup>

### Increased risk of errors

People with sleep deficits are not as productive as they could be, and they are also more prone to making mistakes and errors. An estimated 274,000 insomnia-related workplace accidents and errors occur yearly and cost U.S. employers more than \$31 billion, which is more than any other chronic health-related condition.<sup>13</sup>

### Incidents and crashes

A 2014 study estimated that up to 21% of all fatal vehicle crashes may involve a drowsy driver.<sup>14</sup> Factors that contribute to such crashes include working multiple jobs, working nights or other unusual schedules, getting less sleep than needed and getting poor-quality sleep.<sup>15</sup> Long commutes contribute to longer waking days and cut into time available for sleep, putting many workers at increased risk for driving while drowsy.

### In a study of 10 years of National Transportation Safety Board investigations, researchers found:

**20% of accidents were related to fatigue, with 40% of highway crashes involving fatigued drivers.**<sup>16</sup>

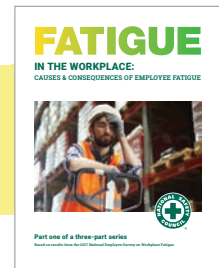


### Presenteeism in Tired Employees

Employees who sleep less than seven hours a day lose up to four days a year in presenteeism, where they're present but not productive at work. Employees with untreated sleep disorders such as insomnia can lose up to 11 days a year.



Learn more in the NSC report  
***Fatigue in the Workplace:  
Causes & Consequences of  
Employee Fatigue***  
[nsc.org/FatigueReport](https://nsc.org/FatigueReport)



<sup>10</sup>Wickwire, E.M., Shaya, F.T., & Scharf, S.M. (2016). Health economics of insomnia treatments: The return on investment for a good night's sleep. *Sleep Medicine Reviews*, 30:72-82.

<sup>11</sup>Stewart WF, Ricci JA, Chee E, & Morganstein D. (2003). Lost productive work time costs from health conditions in the United States: results from the American Productivity Audit. *Journal of Occupational and Environmental Medicine*, 45 (12):1234-1246.

<sup>12</sup>Gingerich, S. B., Seaverson, E. L., & Anderson, D. R. (2018). Association Between Sleep and Productivity Loss Among 598 676 Employees From Multiple Industries. *American Journal of Health Promotion*, 32 (4), 1091-1094.

<sup>13</sup>Shahly, V., Berglund, P.A., Coulouvrat, C., et al. (2012). The associations of insomnia with costly workplace accidents and errors: results from the America Insomnia Survey. *Archives of General Psychiatry*, 69 (10), 1054-1063.

<sup>14</sup>Tefft, B. C. (2014). Prevalence of motor vehicle crashes involving drowsy drivers, United States, 2009-2013. Washington, DC: AAA Foundation for Traffic Safety.

<sup>15</sup>Stutts, J. C., Wilkins, J. W., Osberg, J. S., & Vaughn, B. V. (2003). Driver risk factors for sleep-related crashes. *Accident Analysis & Prevention*, 35 (3), 321-331.

<sup>16</sup>Marcus, J. H. & Rosekind, M. R. (2017). Fatigue in transportation: NTSB investigations and safety recommendations. *Injury Prevention*, 23 (4), 232-238.

### **Fatigue: an under-recognized hazard**

While fatigue can affect people quite significantly, most people don't reliably recognize the extent they are impaired by sleep loss, typically reporting themselves to be more alert than they really are when tested with objective measures.<sup>2</sup> Researchers think there may be a misperception of adaptation to sleep loss that occurs over time, as many people are chronically sleep deprived.

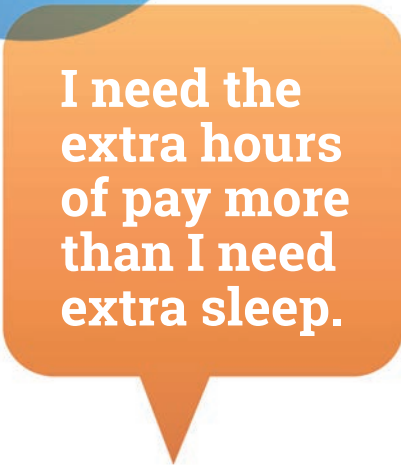
### **Common misperceptions**



Fatigue is just laziness.



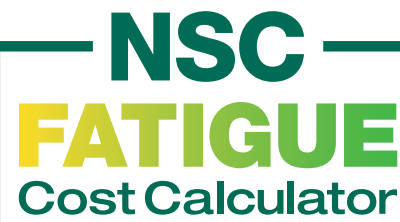
I've worked 16 hours straight before, and was fine.



I need the extra hours of pay more than I need extra sleep.

### **Fatigue culture is difficult to overcome**

A workplace culture that rewards or tolerates fatigue can also be a factor. In some high-performance cultures, employees may view fatigue as a sign of weakness or laziness. They may be committed to getting the work done despite long hours, even coming to believe fatigue doesn't affect them. Employers may incentivize long hours with financial incentives or promotions, increasing risk and promoting a culture of burnout instead of managing fatigue as a potential safety hazard.



## **NSC FATIGUE Cost Calculator**

### **Cost of a tired workforce**

NSC in collaboration with the Brigham and Women's Hospital Sleep Matters Initiative developed an online fatigue cost calculator that estimates the cost of sleep deficiency for individual businesses. Entering four data points into the calculator – workforce size, industry, location, and shift scheduling practice – generates an estimated dollar cost that helps the organization quantify the cost of fatigue and justify the implementation of a fatigue risk management system (FRMS).

The cost calculator and the methodology used to create it are detailed in *Calculating the Cost of Poor Sleep: Methodology* at [nsc.org/tiredatwork](http://nsc.org/tiredatwork).

# FATIGUE RISK MANAGEMENT SYSTEMS

We all need regular, good-quality sleep to perform at our best. However, our 24/7 culture requires services and operations around the clock that interfere with the physiological drive for nighttime sleep and daytime wakefulness. It is inevitable that people supporting such operations will be challenged by limited nighttime sleep opportunities and disruptions to their body clocks.

## **Fatigue management as part of safety management systems**

Workplace fatigue should be addressed through the same types of safety management mechanisms that an organization uses to address overall safety. Such an approach ideally applies multiple elements, recognizing that fatigue is a complex issue that can be minimized but not completely eliminated.<sup>17,18</sup>

## **Getting started with a fatigue risk management system**

Fatigue management is a way to further enhance a current safety management system and can rely on many existing mechanisms. As a first step, organizations should make an effort to understand what fatigue risks exist.

## **Incremental components or comprehensive plan**

While a comprehensive fatigue management program may be the best approach, especially for larger organizations, individual elements can be tested to start with. An initial element, perhaps smaller in scope, can be implemented and evaluated. Lessons learned can then be applied as the element is expanded upon and other activities are considered.

## **Form a fatigue committee**

Designating an individual, or individuals, to lead fatigue management activities is critical for success. For larger organizations, a small committee can oversee activities, gather and evaluate feedback, and determine areas to focus efforts. Having representatives from across the organization such as safety, operations, and health/wellness will ensure that different perspectives are included from all aspects of the organization's operations.

## **Getting buy-in**

It is important that the fatigue management process be transparent and that appropriate information is shared throughout the effort to obtain buy-in from all levels of the organization. Providing open forums that allow employees to share how fatigue affects them is one way to get engagement from the outset.


## **Identifying fatigue risks**

In addition to employee input, an audit or survey of supervisors and managers can help identify where fatigue risks exist and provide an indication of the magnitude. Such information can help prioritize what countermeasures or mitigation actions can be taken and where to focus efforts. For the initial activities, it is important to present some action in the near term so contributors will feel their input was and is incorporated. As a result, they are more likely to be engaged in the ongoing process and actions.

<sup>17</sup>International Air Transport Association. (2015). Fatigue Management Guide for Airline Operators. ICAO Fatigue Management Guide for Airline Operators. [https://www.icao.int/safety/fatiguemanagement/FRMS%20Tools/FMG%20for%20Airline%20Operators%202nd%20Ed%20\(Final\)%20EN.pdf](https://www.icao.int/safety/fatiguemanagement/FRMS%20Tools/FMG%20for%20Airline%20Operators%202nd%20Ed%20(Final)%20EN.pdf)

<sup>18</sup>Gander, P., Graeber, R. C., & Belenky, G. (2011). Fatigue risk management. *Principles and practice of sleep medicine, fifth edition* (760-768).





## **Key components of a fatigue risk management system (FRMS)**

**Education and training**

**Policies and practices**

**Shared responsibility**

**Fatigue mitigation**

**Data-driven programs and  
continuous improvement**

# EDUCATION AND TRAINING

## Sleep health education

Sleep health education is a critical element of any fatigue management effort. Different delivery mechanisms can be considered and may be used over time as the program matures as a way to help keep information fresh. Depending on available resources, external expertise can be beneficial. In a public safety setting, expert-led sleep health training resulted in knowledge acquisition and subsequent actions to address sleep issues.<sup>19</sup> Sleep health education should be considered as part of annual, recurrent or new-hire training.

**Education and training raise awareness of risks, create motivation to prioritize rest, and provide information on how to manage fatigue and get proper rest.**

## Core components of a comprehensive sleep health program

<b>Fundamentals of sleep</b>	<ul style="list-style-type: none"> <li>• Physiological need for sleep</li> <li>• Different stages of sleep, light and deep</li> <li>• Sleep disorders</li> <li>• Factors that affect sleep including alcohol, age, environmental and other health conditions</li> </ul>
<b>Circadian rhythms</b>	<ul style="list-style-type: none"> <li>• Circadian clock programs us for nighttime sleep and daytime wakefulness</li> <li>• Daily periods of increased wakefulness and sleepiness</li> <li>• The powerful influence light has on the clock</li> <li>• A variety of daily functions are dictated by the clock, including digestion</li> <li>• Early bird/night owl individual variations</li> </ul>
<b>Effects of fatigue</b>	<ul style="list-style-type: none"> <li>• Sleep loss and fatigue affect all aspects of human functioning, both physically and mentally</li> <li>• Impaired cognitive function is of special concern for those in safety-sensitive positions</li> <li>• Fatigue degrades decision-making, worsens memory and slows reaction times</li> </ul>
<b>Individual differences</b>	<ul style="list-style-type: none"> <li>• The typical adult needs seven to nine hours of sleep on a daily basis</li> <li>• Some people are more vulnerable to sleep loss than others, and will be at increased risk when they haven't met their sleep need over time<sup>2</sup></li> <li>• Circadian rhythms may vary with some people being more alert, or more sleepy, at different times of day</li> </ul>
<b>Strategies for better sleep</b>	<ul style="list-style-type: none"> <li>• Keep a regular bedtime</li> <li>• Limit caffeine, alcohol and nicotine close to bedtime</li> <li>• Limit technology use close to bedtime: cell phones, computers, TVs and any bright screens</li> <li>• Practice relaxation techniques and a regular pre-sleep routine</li> </ul>

<sup>19</sup>Barger, L. K., O'Brien, C. S., Rajaratnam, S. M., Qadri, S., Sullivan, J. P., Wang, W., ... & Lockley, S. W. (2016). Implementing a sleep health education and sleep disorders screening program in fire departments: A comparison of methodology. *Journal of Occupational and Environmental Medicine*, 58 (6), 601.



## Sleep health education and workplace wellness programs

Healthy sleep, good nutrition and regular exercise are all key to health and a good quality of life, so sleep health education is a natural fit for workplace wellness programs.

## Sleep disorder screening

Including screening for sleep disorders can enhance existing corporate health and wellness events and programs.<sup>20</sup> A number of available screening tools can identify people who may have sleep disorders.<sup>21, 22</sup> Follow-up procedures should be developed that facilitate the process for screened workers to meet with sleep medicine specialists for further evaluation and potential treatment options.

Follow-up and ongoing activities are encouraged.

A study in a ground transportation operation with an employer-provided treatment program for sleep apnea found that workers who were non-compliant had significantly more work-related incidents.<sup>23</sup>

## Sleep challenges

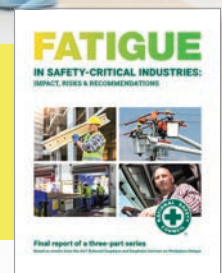
A sleep challenge provides a way to engage employees and raise awareness about the value of good sleep. This can be a promotional activity that challenges workers to get the recommended seven or more hours of healthy sleep for a period of time. Incentives can be provided for those that reach the goal. Getting participation from all levels of the organization, including management or other high-profile personnel, can help fuel a friendly competition that has benefits for all.

## Tracking and counteracting fatigue symptoms

While individuals are generally unreliable at recognizing the effects of fatigue in themselves,<sup>2</sup> developing a personal signs and symptoms checklist can provide a structured mechanism for self-assessment. People should include ways in which fatigue affects them, such as yawning or being forgetful, and then track number of hours of sleep in the past 24 hours, hours awake, and time of day. If a number of fatigue factors are present, then the individual should seek out countermeasures to boost alertness.



See the NSC report *Fatigue in Safety-critical Industries: Impact, Risks & Recommendations* for a case study detailing a successful corporate sleep apnea program.



<sup>20</sup>Fuller, J. M., Wong, K. K., Krass, I., Grunstein, R., & Saini, B. (2011). Sleep disorders screening, sleep health awareness, and patient follow-up by community pharmacists in Australia. *Patient Education and Counseling*, 83 (3), 325-335.

<sup>21</sup>Stiasny-Kolster, K., Mayer, G., Schäfer, S., Möller, J. C., Heinzl-Gutenbrunner, M., & Oertel, W. H. (2007). The REM sleep behavior disorder screening questionnaire—a new diagnostic instrument. *Movement Disorders*, 22 (16), 2386-2393.

<sup>22</sup>Chung, F., Yegneswaran, B., Liao, P., Chung, S. A., Vairavanathan, S., Islam, S., ... & Shapiro, C. M. (2008). Validation of the Berlin questionnaire and American Society of Anesthesiologists checklist as screening tools for obstructive sleep apnea in surgical patients. *Anesthesiology: The Journal of the American Society of Anesthesiologists*, 108 (5), 822-830.

<sup>23</sup>Burks, S.V., Anderson, J.E., Bombyk, M., Haider, R., Ganzhorn, D., Jiao, X., ... Kales, S.N. (2016). Nonadherence with employer-mandated sleep apnea treatment and increased risk of serious truck crashes. *Sleep*, 39 (5), 967-975.



### **Clarify roles and expectations**

A recognized internal point of contact with responsibility for fatigue management efforts is a necessary first step towards effective implementation. This individual should be responsible for managing communications about the program and coordinating all program activities. This “fatigue champion” recognizes both the benefit to the organization and to employees’ lives. The champion can provide an extra level of motivation and inspiration that can lead to an exceptional fatigue management program.

### **Policies and practices for work periods**

Effective policies and practices for hours of work and rest should be science-based, and recognize the physiological need for sleep and circadian rhythms. They should also take into consideration the type of work that needs to be done and recognize characteristics of the workforce. There is no “one size fits all” number for daily or weekly work hours.

#### **Daily and weekly limits**

Daily fatigue risks increase with more hours on duty, or with more time on task (hours of work without break). Daily work limits should also address the impact of hours awake, and how factors such as commute times and shift start times will affect the amount of time workers are awake prior to the start of their work period.

Sleep loss over the course of a workweek impairs performance. Setting weekly limits on total work hours and including a provision for a weekly off-duty “reset” period are common ways that organizations seek to manage the cumulative effects of sleep loss over time. The intent of the “reset” day or days off is to allow workers to obtain recovery sleep and be rested and ready for their next period of workdays.

#### **Time-of-day fatigue (circadian rhythm misalignment)**

Working at night and corresponding daytime sleep are both misaligned with the normal circadian rhythms. Fatigue risks increase during night shifts, and sleeping during the day is less than optimal due to the circadian clock. For those working a night shift, consideration should be given to minimizing boring or monitoring tasks that can unmask underlying sleepiness, and safety-sensitive tasks should be scheduled earlier in the shift when possible.

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**Early morning shifts require employees to adjust their sleep schedules, which might lead to chronic sleep loss. They also require employees to be alert when their bodies are still in sleep mode.**

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### Limits on night shifts

With increased fatigue risks associated with working at night, employers should consider implementing shorter night shifts.

This provides a way to minimize the interaction of risks associated with hours awake and the increased likelihood of fatigue during the low point in circadian rhythms. Fatigue risks have also been found to increase over consecutive night shifts, so minimizing multiple nights in a row and providing regular breaks should be considered.<sup>24</sup>

### Limits on early morning shifts

Early-morning shift starts can also infringe on individuals' normal sleep periods. With long commutes, wake times necessary for early shift starts may feel more like the middle of the night than morning. The ability to get adequate sleep in these circumstances is further challenged by the difficulty in getting to bed earlier than our circadian clock's programming.<sup>25, 26, 27</sup>

### Non-standard operations

In some workplaces, employees may need to be available for work during on-call periods. This may lead to working more hours than scheduled. Without the ability to reliably plan for sleep while on call, employees may also experience additional stress due to the unpredictability. This may affect sleep quality and lead to increased fatigue during subsequent duty.<sup>28, 29</sup>

### Limits on work hours

While flexibility is necessary in many situations, additional limits should be considered for those working irregular schedules, for example limiting the number of on-call periods per week.

### Managerial oversight of overtime

Direct supervisors should maintain close oversight of employees working high amounts of overtime or on-call hours.

### Contract workers

Temporary or contract workers present another potential challenge. They often have financial motivations to work long hours or any available shifts. Management should monitor such hours and ensure that workers take adequate rest periods and avoid working excessive hours to properly manage fatigue for the workplace as a whole. Fatigued co-workers, regardless of their employment status, can cause productivity drains and safety incidents that affect the entire workforce.

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## Shift scheduling for fatigue risk management includes both work and rest scheduling.

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### Vulnerable population: Shift workers and drowsy driving

Shift workers are vulnerable to fatigue because of non-traditional work schedules that might require long shifts, non-daytime working hours, and changing schedules. As a result, shift workers are at a higher risk of drowsy driving.

One shift-working population that is at particular risk is medical workers, who can log more than 100 hours in a workweek with very little sleep. After an extended shift, medical interns were five times more likely to have a near-miss incident on their commute home, and twice as likely to have a motor vehicle crash.<sup>30</sup>

<sup>24</sup>Folkard, S., & Tucker, P. (2003). Shift work, safety and productivity. *Occupational Medicine*, 53 (2), 95-101.

<sup>25</sup>Flynn-Evans, E. E., Arsintescu, L., Gregory, K., Mulligan, J., Nowinski, J., & Feary, M. (2018). Sleep and neurobehavioral performance vary by work start time during non-traditional day shifts. *Sleep Health*, 4 (5), 476-484.

<sup>26</sup>Strogatz, S. H., Kronauer, R. E., & Czeisler, C. A. (1987). Circadian pacemaker interferes with sleep onset at specific times each day: role in insomnia. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 253v(1), R172-R178.

<sup>27</sup>Dijk, D.J., & Czeisler, C.A. (1994). Paradoxical timing of the circadian rhythm of sleep propensity serves to consolidate sleep and wakefulness in humans. *Neuroscience Letters*, 166 (1), 63-68.

<sup>28</sup>Ziebertz, C. M., van Hooff, M. L., Beckers, D. G., Hooftman, W. E., Kompier, M. A., & Geurts, S. A. (2015). The relationship of on-call work with fatigue, work-home interference, and perceived performance difficulties. *BioMed Research International*. DOI:10.1155/2015/643413.

<sup>29</sup>Golden, L. (2015). Irregular work scheduling and its consequences. *Economic Policy Institute Briefing Paper No. 394*. Retrieved from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2597172](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2597172)

<sup>30</sup>Barger, L. K., Cade, B. E., Ayas, N. T., Cronin, J. W., Rosner, B., Speizer, F. E., & Czeisler, C. A. (2005). Extended work shifts and the risk of motor vehicle crashes among interns. *New England Journal of Medicine*, 352 (2), 125-134.



### **Policies and practices for rest periods**

Scheduling policies should include provisions for minimum periods of time-off duty. The intent of these periods is to allow workers an opportunity to obtain a quality sleep period prior to their next work period. Policies should recognize that some individuals need more than eight hours of sleep to be fully rested. They also should take into consideration commuting and personal time.

### **Shift returns**

Shift timing when returning to work will influence the value of the rest period in providing sufficient time for sleep. Additional rest time should be considered for night shifts and early morning starts, as the ability to get recovery sleep at night will be limited.

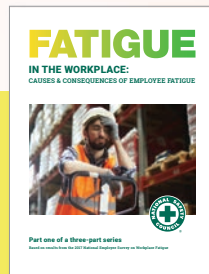
### **Timing of sleep periods**

Nighttime sleep periods produce the best quality and quantity of sleep. When full nighttime sleep periods are not possible, shorter “anchor” sleep periods may allow individuals to align at least part of their sleep opportunity with their normal sleep timing and provide for an improved sleep opportunity.<sup>31</sup>

### **Compensatory rest periods**

Following periods of extended working hours due to overtime, emergency response or call-ins, additional time should be allowed for recovery sleep. Given that individuals’ circadian rhythms may be disrupted following these situations, more than a one-night sleep opportunity will be necessary to get the quantity and quality of sleep to become fully rested.

**67% of survey respondents who work multiple jobs reported working 50 or more hours a week, putting them at risk for sleep deprivation. Find out more in the NSC report *Fatigue in the Workplace: Causes and Consequences of Employee Fatigue***



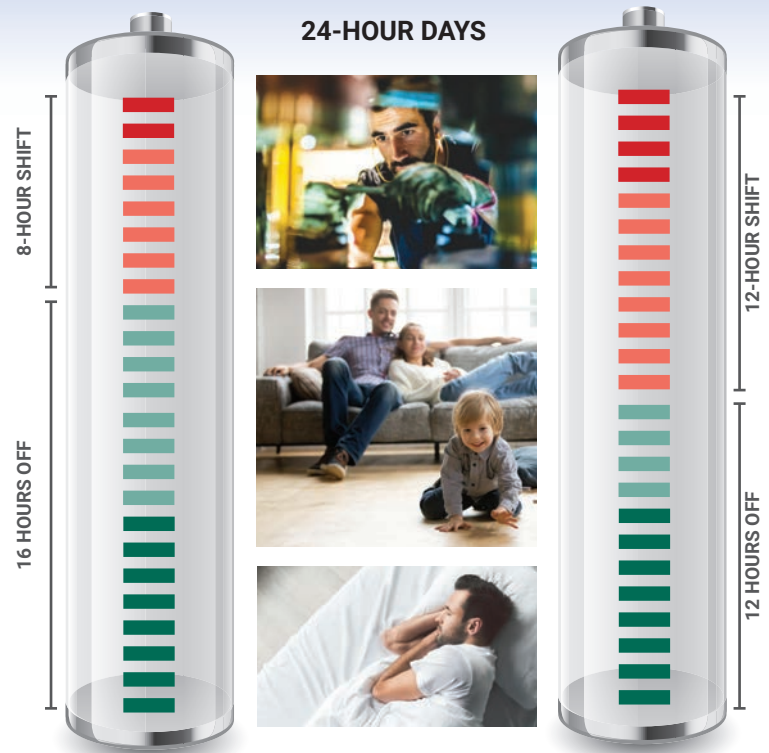
<sup>31</sup>Reid, K. (2011). Anchor Sleep/Nap Sleep Strategies Aboard Towing Vessels. Retrieved from <https://pianc.us/wp-content/uploads/2016/07/Smart-River-Reid-September-14-2011.pdf>



# SHARED RESPONSIBILITY

## Fit for Duty

An employee arriving fit for duty is the responsibility of both the employer and the employee. Employers should ensure employees have at least 12 hours off between shifts to get proper sleep. Employees are responsible for allocating their off-the-job hours wisely, especially if they are working a second job.



## DO YOUR EMPLOYEES HAVE ENOUGH TIME TO RECHARGE?

Employees need time to take care of responsibilities and recharge outside of work. Longer shifts pressure employees to choose between sleep and other activities. Allowing employees ample time to recharge outside of work can increase safety at work.

**Fatigue management is a shared responsibility between employers and employees.**

Employers	Employees
Ensure employees have plenty of time off between shifts, at least 12 hours, to get rest	Should report rested for work and be fit for duty
Allow employees to feel safe reporting fatigue-related issues within a non-punitive structure	Recognize their own personal limits (not the same for everyone)
Create systems to gather data, review data and apply findings to improve processes	Report issues through appropriate mechanisms
Educate employees on causes and consequences of fatigue, how to identify fatigue symptoms, and the importance of keeping each other safe	Look out for each other, note signs or symptoms in co-workers and encourage taking action; buddy system
Get input from employees on fatigue hazards and mitigation strategies	Recognize fatigue as a hazard to promote a culture of safety
“Walk the talk”	Managers and supervisors need to demonstrate the importance of these activities for themselves, helping create buy-in



A workplace with positive environmental controls promotes better overall working conditions, and should be less physically stressful in ways that contribute to fatigue on the job. Factors such as high temperatures, noise and vibration have been found to be leading drivers of occupational fatigue.<sup>32</sup>

**Environmental controls**

Environmental factors can play a role in employees’ accumulation of fatigue.<sup>33,34</sup>

Promotes alertness	Increases fatigue
Moderate temperature	Extreme temperature
Bright lighting	Dim lighting
Clean air	Polluted air
Quiet environment	Loud environment

**Designated break areas**

Designated break areas sufficiently separated from the worksite can be an important tool in managing fatigue. Bright lighting can have an energizing effect. Break time in moderate temperatures and adequate ventilation can provide an opportunity to reset for those working in physically stressful settings.



<sup>32</sup>Techera, U., Hallowell, M., Stambaugh, N., & Littlejohn, R. (2016). Causes and consequences of occupational fatigue: Meta-analysis and systems model. *Journal of Occupational and Environmental Medicine*, 58 (10), 961-973.  
<sup>33</sup>Slama, H., Deliens, G., Schmitz, R., Peigneux, P., & Leproult, R. (2015). Afternoon Nap and Bright Light Exposure Improve Cognitive Flexibility Post Lunch. *PLOS ONE*, 10 (5): e0125359. <https://doi.org/10.1371/journal.pone.0125359>  
<sup>34</sup>Kjellberg, A., Muhr, P., & Skoldstrom, B. (1998). Fatigue after work in noise-an epidemiological survey study and three quasi-experimental field studies. *Noise and Health*, 1 (1), 47.

## Nap breaks

Allowing employees to take breaks as needed can reduce time-on-task fatigue and promote subsequent alertness. Opportunities for short naps during breaks can be a powerful option for managing fatigue, especially for employees working long hours or overnight shifts. Even a 10–20 minute nap in a quiet, dark setting with the ability to recline can produce benefits, leading to reduced sleepiness and improved performance when returning to the job.<sup>35,36</sup>

**Allowing employees to take breaks as needed can reduce the accumulation of time-on-task fatigue and boost alertness during a shift.**



## Countermeasures to boost alertness

### Caffeine

Caffeine can provide a short-term boost to alertness when used properly. Rather than relying on caffeine throughout a shift, it is best to use it just before a critical work task or prior to the mid-afternoon period when sleepiness occurs. A cup of regular coffee with 100–200 mg of caffeine can boost alertness up to four hours, with about 15–30 minutes needed to take effect. Be cautious with sugar in coffee or caffeinated beverages, as it can reduce alertness when coming down from the “sugar high.”



### Physical activity

When working in a sedentary or monitoring position, brief periods of physical activity can provide a short-term boost to alertness. Standing and stretching or taking a short walk can help to get the blood flowing and increase alertness. Fresh air and sunshine can add to the benefit. A NASA study provided pilots with a seven-minute activity break during simulated night flights and alertness was improved for a short period of time after the break.<sup>37</sup>



### Naps

Even a 10–20 minute “power nap” can boost alertness. A number of studies have found improved alertness for a period following the nap. Ideally, a separate, quiet, dark room should be available in which individuals can nap. Sleep inertia, the feeling of grogginess when first awakening from sleep, can have an effect on performance for a short period after napping.



### Breaks

Regular short breaks during work shifts may be more effective at maintaining alertness and performance than a single long break, and provide an opportunity for recovery from time-on-task effects. Data from work settings show reduced rates of safety risks when breaks are taken regularly.<sup>38</sup> In addition, breaks provide opportunities for social interaction with co-workers and exposure to bright light in break rooms, both of which can provide additional benefits to alertness.



Asking employees to keep an eye out for their co-workers can be helpful, too. If they notice any unusual symptoms in others, especially near the end of long work shifts or at night, fatigue may be a factor, and a break or other countermeasure should be considered.

<sup>35</sup>Tietzel, A. J., & Lack, L. C. (2001). The short-term benefits of brief and long naps following nocturnal sleep restriction. *Sleep, 24* (3), 293-300.

<sup>36</sup>Ruggiero, J. S., & Redeker, N. S. (2014). Effects of napping on sleepiness and sleep-related performance deficits in night-shift workers: a systematic review. *Biological Research for Nursing, 16* (2), 134-142.

<sup>37</sup>Neri, D., Oyung, R., Colletti, L., Mallis, M., Tam, P., & Dinges, D. (2002). Controlled Breaks as a Fatigue Countermeasure on the Flight Deck. *Aviation, Space, and Environmental Medicine, 73* (7), 654-64.

<sup>38</sup>Folkard, S., & Lombardi, D. A. (2006). Modeling the impact of the components of long work hours on injuries and accidents. *American Journal of Industrial Medicine, 49* (11), 953-963.



# DATA-DRIVEN PROGRAMS AND CONTINUOUS IMPROVEMENT

A fatigue management program provides the most value when it is data-driven and strives for continuous improvement.

## **Ask employees for input**

Employees can be a wealth of information. You just need to ask and listen.

- **What mitigation strategies work best?** Employees may have valuable feedback on environmental conditions and the usability of a break room, for example.
- **What adds to your fatigue?** Annual surveys of employees on their experiences and perspectives on fatigue-related matters are a great way to get a better understanding.

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**Low reporting levels? Maybe the system isn't working. Don't assume that low reporting levels mean there are no issues. Are reporting and monitoring systems effective? Usable? Are employees discouraged from reporting?**

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### Monitoring and reporting

Monitoring and reporting mechanisms allow the program champion and other safety managers to assess the levels of fatigue risk in the organization over time, identify trends, and understand the issues that are being reported and need addressing. Reporting processes can be incorporated into current procedures within an existing safety management system. Keep in mind that when a program is first implemented, low levels of reporting may indicate a lack of awareness of the program rather than a lack of fatigue-related issues in the workplace.

### Incident and accident investigation reporting

Established incident and accident investigation processes should be expanded to include an evaluation of the potential role of fatigue. Generally, a combination of factors present at the time of an incident/accident would indicate that fatigue played a role. The following factors should be included:

Time on duty at time of event	More hours on duty may increase the likelihood of fatigue
Time awake at time of event	When hours awake exceed 17, fatigue becomes more likely
Length of the work week	More consecutive days or nights of work may lead to increased fatigue
Self-report information on alertness	Use standard measures such as Samn-Perelli fatigue <sup>39</sup> or sleepiness scales
Self-report information on sleep history (prior sleep/nap periods)	Investigators should gather information on prior sleep history to best assess the potential influence of the above factors

### Review and learn from data

Incident and accident reports can be a valuable tool for the fatigue program manager. Look for trends in the types and sources of reported fatigue factors. Investigations can provide valuable "lessons learned" to incorporate into ongoing education and training activities.

### Continuous improvement: collecting data and applying lessons learned

As with any organizational safety-related effort, it is important to seek ways to continue improving operations. Monitoring and reporting information, along with incident or accident investigation and reporting, provides valuable information to the program manager. What is working? What isn't? What can be done better? Employers should consider a regular internal audit or use of an external evaluator to address the above questions and determine ways for further improvements and expand the program.

**An important aspect of an effective fatigue management program is to have monitoring and reporting mechanisms in place.**

<sup>39</sup>Samn, S. W., & Perelli, L. P. (1982). Estimating aircrew fatigue: a technique with application to airlift operations (No. SAM-TR-82-21). School of Aerospace Medicine, Brooks Air Force Base, TX

# FATIGUE MANAGEMENT TOOLS



## **Scheduling software**

Some industries, such as aviation, use programs that evaluate work schedules for potential fatigue risks as part of their fatigue management efforts. Such programs use science-based algorithms related to factors such as sleep need, circadian disruption, hours awake and time of day. Safety managers then evaluate work schedules for potential issues and implement strategies that will attempt to address the issues and minimize risks.

## **Risk assessment tools**

Simpler risk assessment tools with similar goals can also be used. Factors to consider include the length and timing of work periods, time-on-task, workload, consecutive days or nights of work, variations in work schedule, and timing and duration of rest periods. Other factors that could be considered include worksite environmental conditions, commute times and other potential stressors such as critical deadlines. Safety managers can similarly evaluate potential risks with this approach and determine interventions to minimize those risks.



# SUMMARY

1. An integrated, multi-element fatigue program is most beneficial, though implementation of incremental activities may be more feasible for smaller companies or those with limited resources
2. Fatigue champions should remain aware that change is difficult and should be managed with care; highlight benefits for employees such as quality of life and improved health
3. Transparency and shared information is important in getting buy-in from all participants
4. Data-driven processes provide important empirical information on what issues exist within an organization, and provide a framework for continued improvements to the program



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