Worker Fatigue: An “Eye-Opening” Safety and Health Epidemic

Kurt VonRueden, CSP, CET
Loss Control Consultant
Meadowbrook Insurance Group
Bloomington, MN

Introduction

You are conducting an incident investigation of an event that left a production employee with a partially amputated index finger. All of the facts and information have been gathered and you appear to have found the “root cause” which was operator error- the employee activated the wrong control button while his hand was removing a part stuck inside the point of operation without locking out the machine. There is still one question which remains- “Why did this veteran employee inadvertently activate the wrong button?” This is an important and valid question because this same employee has operated this machine for several years so he was very familiar with its operation. Also, the two control buttons on this machine that were part of this incident were located six feet apart from each other- the wrong “Hydraulic Cylinder Forward” button that was activated located outside the machine and the correct “Ejector Retract” button located inside the machine. The answer to this very important question was “extreme operator fatigue”. Working 55-60 hours per week on third shift took its toll on this machine operator as his “sleep debt” accumulated enough to the point that this employee had impaired judgment and compromised decision-making ability leading to an unsafe action.

If we take a look back at recent history, there are several examples of accidents and catastrophes where worker fatigue and sleep deprivation contributed and played a role in causing these events including:

New York City Commuter Train Derailment- 2013
Exxon-Valdez Tanker Spill- 1989
Chernobyl Nuclear Reactor- 1986
Union Carbide Chemical Plant in Bhopal- 1984
Three Mile Island- 1979

Sleep studies have determined that sleep deprivation can lead to unsafe acts and behaviors, and unfortunately some of the workers involved in the above catastrophic events were experiencing fatigue due to lack of sleep and long hours of work. Prior to the December 1, 2013 New York City Commuter Train Derailment incident, unfortunately when the news of these tragic events was released, the public was not informed of the role that worker fatigue played in
causing these catastrophes. This has contributed to the lack of emphasis and focus which healthy sleep and rest deserve.

**Consequences of Sleep Deprivation and Worker Fatigue**

As Safety and Health professionals, I am sure that we would all agree that impaired reaction time, judgment and vision along with increased moodiness and aggressive behaviors are not good for workplace safety, but did you know that these are all effects of sleepiness and fatigue on employees who are sleep deprived? Sleep deprivation has been linked to risk-taking behavior. In fact, the level of risk from being injured at work increases greatly for those employees that are tired and fatigued. It has been estimated that these highly fatigued workers are 70% more likely to be involved in accidents and those who report disturbed sleep are nearly twice as likely to be killed in a work-related incident.

When we take into consideration what it costs, sleep-related fatigue costs for U.S. businesses have been estimated at $150 billion a year due to:

- Absenteeism
- Workplace accidents
- Lost productivity

Two thirds of adults report experiencing sleep problems at least a few nights per week according to a 2008 sleep study. When you take a closer look at the effects of sleepiness in the workplace, according to a 2008 National Sleep Foundation “Sleep In America Poll”, sleep deprived employees reported having difficulty with the following:

- Concentration 68%
- Handling stress 65%
- Listening 57%
- Solving problems 57%
- Decision making 56%
- Relating to others 38%

How many of these states and conditions can affect employee safety performance? The answer is all of them. When we really break down what can lead to unsafe actions and behaviors, you will probably find many of these items listed as contributing factors in the cause of an accident or injury. This same poll identified the following additional work problems that employees encountered due to sleepiness:

- Being late to work 14%
- Staying home from work 4%
- Falling asleep at work 7%
- Making errors 19%

There is no question that all of these issues and problems that employees can encounter due to lack of sleep and rest can greatly affect how safe and productive they are at work. So why
isn’t healthy sleep and proper rest promoted more in the workplace? Why isn’t sleep deprivation and worker fatigue education and awareness included as part of an employer’s Wellness Program?

**Microsleep- A “Hidden and Silent” Danger**

Have you ever driven somewhere and then not remembered part of the trip? If so, you may have experienced “microsleep”. Microsleep refers to brief moments of sleep (2-10 second sleep episodes) that occur when you are normally awake. What makes microsleep so dangerous is that you cannot control or predict it, and you might not even be aware of it.2 Anyone can experience microsleep, but people who are chronically sleep deprived and/or have built up their “sleep debt” (Sleep debt- the amount of sleep that you need each and every night minus the actual number of hours of sleep that you get) to the amount of 10 hours or more are at a higher risk of this “hidden & silent danger”4.

One important focus area with worker fatigue that an organization should consider when implementing and running a Safety and Wellness Program is to identify and monitor “safety-sensitive” job positions. Safety-sensitive jobs and tasks inherently carry more risk and possible exposure to more severe hazards so they usually are monitored more closely when it comes to workplace safety. But what about safety-sensitive jobs and tasks which are considered “sedentary” (EX.- driving a vehicle)? The risk and prevalence of microsleep occurring to an employee increases greatly when performing sedentary jobs and tasks.5

Consider the following event: On Dec. 1, 2013 a train engineer operating a New York City commuter train fell asleep at the controls as the train was traveling 82 mph into a 30 mph curve in the Bronx. The engineer caught himself nodding off at the controls just before the curve but it was too late. The result was a derailment which left seven train cars and the locomotive toppled over with some of the cars just inches from the river. Four people died in the accident and dozens were injured. The engineer of this train experienced a microsleep.6

A common example of the danger of microsleep while performing sedentary work is driving a vehicle. Most of us drive an automobile and there are many job positions that require employees to drive a car. We know that vehicle/car accidents are the number one cause of workplace fatalities, yet almost 20 percent of all serious car crash injuries in the general population are associated with driver sleepiness with an average of over 80,000 crashes per year involving drowsy driving.7 One survey revealed that over one third of working adults admitted that they have nodded off or fallen asleep while driving.7 If a person driving on a highway at 65 mph experiences a microsleep, the distance traveled while driving behind the wheel sleeping is about the length of one football field!7 Promoting healthy sleep and rest in order to reduce fatigue amongst workers in safety-sensitive job positions should be made top priority within a company’s Safety and Wellness Programs.

**Beware of the “Mid-Afternoon Dip”**

While we just covered the dangers of microsleep and the risks imposed on safety-sensitive tasks along with the increased likelihood of occurrence to fatigued workers in sedentary job positions, there is another safety item to take into consideration that you do have some control over when it
comes to handling worker fatigue which is scheduling around the “mid-afternoon dip”. This administrative strategy is to schedule the more safety-sensitive and demanding tasks of your workforce during the times when your employees are most alert. When are employees typically more alert? During the daytime hours which fall outside of the “mid-afternoon dip” which is a time frame approximately between 12:30 PM and 3:00 PM. See Exhibit 1. The mid-afternoon dip represents the period during the day when our circadian rhythms, otherwise known as our internal biological clocks, are at weaker levels and you should avoid scheduling those safety-sensitive and more demanding tasks for your employees during that time of the day. Circadian rhythms are rhythms of alertness, body temperature, and hormone production that are controlled by our biological clocks and go through an orderly series of changes approximately every 24 hours.

Exhibit 1. The Mid-Afternoon Dip represents the time of the day when employees are least alert while performing their jobs due to our biological clocks and circadian rhythms.

What determines our tendency to fall asleep or remain awake? - Our homeostatic sleep drive and the circadian rhythms of our internal biological clocks. Sleep is induced and maintained by our homeostatic sleep drive which strives for at least eight hours of sleep in order to provide for sixteen hours of sustained wakefulness every 24 hours. These two physiological processes are continuously exerting forces inside of us which produces our daily cycle of sleep (homeostatic sleep drive) and wakefulness (circadian rhythms). In summary, the daily cycle of how alert we are and experiencing the mid-afternoon dip is built into each and every one of us and should be taken into consideration when “battling” worker fatigue.
Worker Fatigue as it Relates To Safety and Health

Sleep, like food and water, is essential for life. Sleep is vitally important for all human functioning including cognitive and physical performance. Research has found that sleeping less than seven hours per night increases the risk of disease. Adequate sleep protects our immune system and new evidence shows a relationship to weight gain and aging. In fact one report suggests that by sleeping one extra hour each night, a person could lose up to 11 pounds in one year. Other new research has discovered a biological connection between sleep deprivation and the two bodily hormones that regulate our feelings of hunger and fullness when we eat. The secretion of the hormone called Ghrelin stimulates our appetite and makes us hungry. The other hormone which is secreted is called Leptin. Leptin sends a signal to our brain telling it that we are full and have had enough to eat. Sleep deprivation and fatigue will cause an increase in the amount of Ghrelin secreted making a person hungrier and have more of an appetite than normal. The opposite occurs with Leptin. When tired and fatigued, there is a decrease in the amount of Leptin secreted causing a delay in knowing when we are full or have had enough to eat. This increase in Ghrelin and decrease in Leptin can contribute to obesity and has the opposite effect of helping employees maintain a healthier diet. In addition, sleep deprived workers tend to crave energy-dense foods high in calories, fat, protein, and carbohydrates which can lead to obesity and other health issues.

Other positive health benefits of getting enough sleep and rest include the following:

- Restores energy levels
- Repairs cell damage
- Promotes muscle and tissue growth
- Improves mood and reduces the prevalence of depression

These positive health benefits ultimately mean employees who are more productive, experiencing faster recovery times when injured, and helps to improve morale in the workplace.

In 2006, The Institute of Medicine published and issued a report stating the fact that extended sleep deprivation can cause extreme chronic health problems and consequences including an increased risk of hypertension, diabetes, obesity, depression, heart attack, and stroke. The Institute of Medicine report titled “Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem” stated “the cumulative effects of sleep loss and sleep disorders represent an under-recognized public health problem and have been associated with a wide range of health consequences……hundreds of billions of dollars a year are spent on direct medical costs related to sleep disorders such as doctor visits, hospital services, prescriptions, and over-the-counter medications.”

A healthier workforce is going to be a safer workforce. In addition, if an employee becomes injured or ill they will have faster rehabilitation recovery times which will help to lower an organization’s Workers Compensation costs.
The Sleep Deprivation and Worker Fatigue Epidemic

The average American sleeps less than seven hours each night. This contributes to 37% of adults who admit it and say that they are so tired during the day that it interferes with their daily activities. How much sleep do we really need? Your sleep need is the average amount of sleep you must obtain on a daily basis to maintain alertness and avoid building up a “sleep debt”. Most adults need between 7-9 hours of sleep each night.

As a society, we are becoming more chronically sleep deprived than ever before with one third of our population sleeping less than six hours each night. If we take a look back in history we will notice an alarming trend with the average amount of sleep that adults get each night:

1879- 10 hours
1910- 9 hours
1980- 8 hours
2010- 7 hours
2015- Less than 7 hours

This trend indicating the average amount of sleep we are getting each night is going the wrong direction and has decreased the amount of sleep we get by almost 25% since 1980 alone - why?

In just the last 20 years we have added 158 hours to our annual working and commuting time- the equivalent of a full month of working hours. We now live in a 24-hour society where sleep is not valued. With heavy demands of work, household chores, parenting and family responsibilities, and a desire for social life, exercise, and recreation, four out of every ten of us are cutting back on sleep to gain time for what we believe is more important or interesting. The real question now is- How long can we as a society remain healthy and safe if this trend continues?

Integrating Healthy Sleep Initiatives into a Safety and Wellness Program

While you cannot force your employees to utilize better sleep practices (“sleep hygiene”) and get more rest, you can sure educate them and raise their awareness. We know employees do not want to be injured on the job or be involved in an accident. Since sleep research studies and information on how sleep deprivation and fatigue effects our health and safety is a relatively “new frontier” (1960’s to present), most people do not see or realize a connection between getting injured or being involved in an accident and being fatigued. After gaining upper management support to implement worker fatigue as a wellness initiative, one of your first strategies needs to be communicating to all of your employees the importance of getting healthy sleep and rest and educating them on the possible consequences of working while sleep deprived and fatigued. Part of this educational process should include discussing the possible health effects of being fatigued and the health benefits of sleep and rest so they can understand how proper sleep and rest benefit them on a personal level. Also remember that nobody enjoys being stressed, tired, and irritable because it affects our everyday well-being, yet these are the symptoms of fatigue and sleep deprivation- employees gaining an understanding of this message is very important.
Sleep Hygiene
One of the first items to educate your employees on is sleep hygiene. What is sleep hygiene? Sleep hygiene refers to sleep practices, habits, and environmental factors that are necessary for getting quality restorative sleep. Just as proper housekeeping is important in helping to reduce accidents and injuries in the workplace, sleep hygiene is an important part of maintaining lifestyle habits that keep us from becoming sleep deprived and fatigued.

The first tip for improving your sleep and sleeping better is to stick to a consistent sleep schedule, which means going to bed and waking up at the same time each day including on weekends. This practice helps to set the body’s “internal clock” which regulates our sleep/wake cycles. The following is a list of more sleep hygiene tips that will help you improve and maintain adequate sleep:

- Avoid caffeine and nicotine four to six hours before bedtime
- Avoid alcohol within three hours of going to bed
- Avoid large meals before bedtime and limit late day fluid intake
- Get exposure to natural sunlight- at least 30 minutes each day
- Exercise regularly, but not within three hours of bedtime
- Avoid taking naps late in the day (after 4:00 pm)- 20 minute naps are recommended
- Establish a pre-sleep routine of relaxing activities one hour or so before bed- no electronics

Your sleep environment is also part of your sleep hygiene and should be regulated. Your bedroom should be a quiet, dark, and relaxing environment with a temperature between 60°-75° and the room well-ventilated. Removing all TV’s, computers, electronic “gadgets”, and work materials out of the bedroom will also improve your sleep environment. Your bed should be comfortable and used only for sleeping and not for other activities such as reading, watching TV, or listening to music. When employees who work late shifts are taken into consideration, additional sleep hygiene practices should be incorporated such as darkening the bedroom with light blocking and sound absorbing curtains or shades, wearing eye shades and ear plugs, and disconnecting or powering down telephones and cell phones. Running a “white noise” machine (EX. - Electric fan) might be helpful for “drowning out” noises during the day.

Some of these sleep hygiene tips will be easier to include in your daily and nightly routine than others. The key is to stick with them because then your chances of achieving restful sleep will improve. Keep in mind that not all sleep problems are so easily treated and could signify the presence of a sleep disorder such as sleep apnea, restless legs syndrome, narcolepsy, or another clinical sleep problem. If your sleep difficulties do not improve through good sleep hygiene, you may want to consult your physician or a sleep specialist.

Informational Resources and Tools
There are many sources of information out there on healthy sleep, sleep deprivation, and worker fatigue. Three good resources available that I recommend are the following:

1. National Sleep Foundation (NSF)- www.sleepfoundation.org
2. American Academy of Sleep Medicine (AASM)- www.aasmnet.org
One of the “tools” that you will want to share with your employees is a sleep diary journal. The sleep diary journal documents what time you went to bed and what time you woke up. Other information that you can track in the journal is the following:

- Room temperature
- Environmental disturbances such as noise and light
- Quality of sleep
- Noting of stress level and other moods prior to bed
- Pre-Sleep activities like the timing and amount of exercise, any eating of late day food, when and what medications were taken, when and how much intake of alcohol and/or caffeine, and if any late day naps were taken

Just like an incident or near miss investigation scenario at work, the more information that is documented allows you to assess and evaluate your sleep habits and environmental conditions that you are exposed to. You can then identify any trends and patterns that need to be corrected. Ultimately, the tracking of the amount and quality of sleep that you are getting is important in order to avoid getting into “sleep debt”.

How can I find out if I am sleep deprived and have sleep debt? By trying the Home Sleep Latency Test. Sleep latency is the time spent when you shift from being awake to falling sleep. In order to conduct this test, find a comfortable place to sleep and a volunteer to watch you and record the time from when your head “hits” the pillow to when you fall asleep. After conducting this test three or four times during the daytime or nighttime hours, determine the average amount of time that it takes you to fall asleep. Once you know how long, you can compare it to Table 1 to see where you are at with sleep debt. If this time is less than five minutes, then you have severe sleep debt and immediate action should be taken which might involve going to bed 1-2 hours earlier every night starting right away or going to see a sleep specialist to find out if you have a sleep disorder. The Home Sleep Latency Test is an informational tool that should be shared with employees so that they can try it at home.

<table>
<thead>
<tr>
<th>Time</th>
<th>Sleep Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 minutes</td>
<td>Severe sleep debt</td>
</tr>
<tr>
<td>5-10 minutes</td>
<td>Moderate sleep debt</td>
</tr>
<tr>
<td>10-15 minutes</td>
<td>Mild sleep debt</td>
</tr>
<tr>
<td>15-20 minutes</td>
<td>Little or no sleep debt</td>
</tr>
</tbody>
</table>

Table 1. The Sleep Latency Test is the amount of time that it takes you to fall asleep in order to determine your sleep debt condition.
There is another tool that employees can use to determine their level of fatigue and sleep deprivation which is the Epworth Sleepiness Scale. The Epworth Sleepiness Scale is a scoring system that assigns points to common everyday activities based on the likelihood that you would fall asleep during that activity. The following is the list of those common activities:

- Sitting and reading
- Watching television
- Sitting, inactive in a public place
- As a passenger in a car for an hour without a break
- Lying down to rest in the afternoon
- Sitting and talking to someone
- Sitting quietly after lunch without alcohol
- In a car, while stopped for a few minutes in traffic

Next, you assign a score to each item listed above based on the likelihood that you would sleep doing that activity:

- 0- Would never doze or sleep
- 1- Slight chance
- 2- Moderate chance
- 3- High chance

Then you add up each assigned activity score to get your total score and reference it to the following scale in order to determine your level of sleepiness and fatigue:

- 0-10 Normal Range
- 10-12 Borderline
- 12-24 Abnormal

People who score into the “Abnormal” range might have a sleep debt of 20 hours or more or they might be experiencing a sleep disorder (sleep apnea, restless legs syndrome, and narcolepsy). If someone obtains a score this high (12-24), they are at a much higher risk of having a micro sleep.

Promotional Ideas & the Buddy System

One administrative control you can implement to protect your workers from the effects of fatigue is to use the “Buddy System” where your employees watch over each other and look for the warning signs. Remember, tired and fatigued employees will not recognize their own symptoms or admit that they are sleep deprived similar to what happens to someone suffering from heat stress. What are the signs and symptoms to be looking for? Look and pay attention to these warning signs:

- Dark skin discoloration under the eyes
- Clumsiness & slower reaction time
- Communication difficulties- slurred speech
- Hunger that is difficult to satisfy
• Easily triggered & intense emotions- “on the edge”  
• Low stress tolerance & being more irritable  
• Poor concentration & inability to focus on simple and complex tasks  
• Reduced capacity to remember & forgetfulness

The Buddy System incorporates accountability into the strategy by assigning two employees to check on each other and monitor their “buddy’s” condition which ultimately helps employees to be more responsible for their actions and behaviors.

Regarding promotional ideas and campaigns, this is the area to start getting creative. There are several downloadable brochures, flyers, and posters that you can get from the National Sleep Foundation (NSF) website. The following are a couple of campaign slogans that I have come up with that you are welcome to use:

• “Get Your 8 (hrs.) and Feel Great!”  
• “After 9 (o’clock) it’s Wind Down Time!”  
• “Go To Bed Early for a Better Tomorrow!”

In order to help raise and sustain the awareness of the importance of getting adequate sleep and rest, strive to make your promotional campaign “screamingly visible” to all of your employees.

**Conclusion**

Sleep has been around as long as human beings and is essential for life. Recent research and studies have indicated that proper sleep and rest are also important for being more alert, productive, and safe at work. It contributes to our health, lowering our stress, and how well we age. Sleep affects each one of us and can control our daily lives. It has a lot of “power” so you would think that we would make sleep top priority.

Unfortunately, that is not the case in this day and age. In reality, healthy sleep gets little attention. Our busy everyday lives cause us to take shortcuts and not get the adequate sleep that we need each day. Other reasons contributing to this lower level of attention include the lack of awareness, education, and training.

As employers, we want our employees to be happy, healthy, and safe. There are many benefits to this. What can help you get there? By providing training and education on the many benefits of sleep, how much sleep each one of us should get each day, and also proper sleep hygiene. You also want to make sure that there is an understanding of the consequences of not getting enough sleep and rest and how to avoid getting into “sleep debt”. Expand your Wellness Program to include educational resources on sleep and provide incentives for employees to eat healthier, exercise, track their sleep schedules, practice good sleep hygiene, and to watch over their fellow co-workers to look for signs of fatigue. It is time to “conquer” sleep deprivation and worker fatigue and open everyone’s eyes to the importance and value of healthy sleep.
Bibliography


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