Fatigue Risk Management System for the Canadian Aviation Industry

Introduction to Fatigue Audit Tools
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada and fatigue consultants edu.au of Adelaide, Australia.

The FRMS toolbox includes the following components:

1. **FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue, TP 14572E**: introductory material intended to raise awareness about fatigue

2. **FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees, TP 14573E**: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. **FRMS for the Canadian Aviation Industry: Employee Training Assessment, TP 14574E**: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. **FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System, TP 14575E**: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. **FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines, TP 14576E**: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. **FRMS for the Canadian Aviation Industry: Introduction to Fatigue Audit Tools, TP 14577E**: provides an overview of tools available to employers to help determine whether scheduling provides employees with adequate opportunities to get sufficient sleep

7. **FRMS for the Canadian Aviation Industry: Trainer’s Handbook, TP 14578E**: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants

These documents are available on the Transport Canada web site at www.tc.gc.ca.
# Contents

1. **Introduction** ........................................................................................................................... 1  
   Designing a work schedule ........................................................................................................ 2  
   Providing adequate sleep opportunity .................................................................................... 2

2. **Automated Fatigue Audit Systems** ..................................................................................... 3  
   FAID: Applying a biomathematical model .............................................................................. 6

3. **Manual Fatigue Audit System** ........................................................................................... 17  
   Overview .................................................................................................................................. 17  
   Examples .................................................................................................................................... 19  
   Summary ................................................................................................................................... 20

4. **Conclusion** ........................................................................................................................... 21  
   Beyond Level 1 controls .......................................................................................................... 21  
   Shared responsibility for managing fatigue ........................................................................... 21

**Resources** .................................................................................................................................. 23
The purpose of this guide is to provide an overview of various tools and techniques to ensure that work schedules meet the requirements of a fatigue risk management system (FRMS).

An effective FRMS consists of several levels of fatigue hazard controls (see Developing and Implementing a Fatigue Risk Management System (TP 14575E) for a detailed discussion). One of the first things that companies need to examine is whether the schedule provides employees with an adequate opportunity to get enough sleep to be fit for work (Level 1 control).
Designing a work schedule

In the past, hours-of-service (HOS) rules have been used to ensure that a schedule provides adequate sleep opportunity between shifts and does not result in significant work-related fatigue. In principle, this appears to be a reasonable strategy. However, HOS regulations designed to be applied generically to an entire industry can be inflexible and ineffective for an individual organization. They may not guarantee sufficient sleep opportunity.

In designing an FRMS, it is important to understand that there is no such thing as a perfect schedule. Work schedules need to be structured around competing needs, such as operational safety and employee family and social life. For example, the “family friendliness” of a work schedule is likely to be determined by how much time off it provides during times of high social value (i.e., afternoons, evenings, and weekends). The “sleep friendliness” of a work schedule depends on the breaks it provides during times of high sleep value (i.e., nights between 9 p.m. and 9 a.m.). While sleep should be the primary concern, other factors such as the family and social life of employees should be considered, because they can have a direct effect on whether employees are able to use the time off to sleep. Consulting with employees during the early stages of implementing an FRMS can help find a balance between these competing needs.

Providing adequate sleep opportunity

To determine whether a given schedule may result in work-related fatigue, calculate the sleep opportunity that it provides. There are various ways to do this. This document outlines two methods of managing sleep opportunity:

- **Automated fatigue audit systems.** Biomathematical modelling software has been developed that can predict how much sleep an employee is likely to get in a given schedule. The software is able to calculate a fatigue likelihood score for each employee at any given point in the schedule.

- **Manual fatigue audit systems.** For organizations with relatively simple schedules or that may not want to invest in software, manual calculations can also be performed to generate scores that provide an indication of fatigue likelihood.
Biomathematical fatigue models use algorithms that use the effect of the time of day (circadian or natural body rhythms) and the length of time asleep and awake throughout the overall pattern of work and non-work periods to predict an average level of work-related fatigue for a given schedule. There are currently two kinds of biomathematical models.

One-step models (OSMs) use the timing of sleep, time awake, and circadian rhythms observed in a specific individual (e.g., through activity monitors, such as an actigraph) to predict work-related fatigue. Used this way, OSMs are generally considered a Level 2 control in the fatigue hazard control model (see detailed discussion in Developing and Implementing a Fatigue-Risk Management System (TP 14575E)) because they determine risk based on the actual behaviour of a particular employee rather than the inferred average behaviour of an unspecified person across the entire schedule.

Two-step models (TSMs) use the timing and duration of work and rest periods to estimate the most likely timing of sleep, which is then used to predict work-related fatigue. TSMs are generally considered to be less accurate for a specific individual since predictions are based on estimates of average behaviour and do not generally account for individual differences.

Software packages typically provide graphic representations of the work-related fatigue produced by a given schedule. Some also provide aggregate statistics for groups of employees and produce simple reports that show whether the schedule complies with thresholds established by the company or the regulator for work-related fatigue.

There are a variety of programs available. Two of the most commonly used TSMs are the Fatigue Audit InterDyne (FAID), developed by the Centre for Sleep Research at the University of South Australia and InterDynamics, and the Sleep, Activity, Fatigue and Task Effectiveness (SAFTE), developed by the U.S. Department of Defense.

**Fatigue Audit InterDyne (FAID®)**

FAID predicts fatigue, sleepiness, and performance based on hours of work. The underlying assumption of this program is that fatigue results from an imbalance between work-related fatigue and the opportunity for sleep between shifts. The algorithm takes into account factors such as shift time and length, previous work
schedules, and break times to produce fatigue likelihood scores for each shift. The software estimates fatigue-related risk for groups of workers in a particular schedule rather than for specific individuals.

The program can also calculate the potential effects of travelling through up to three time zones. The time zone feature uses a circadian adjustment rate of an average of one hour per day – slower or faster depending on travel direction.

The data used in the initial development of the software was based on workers’ own reports of fatigue, rather than objective measures of fatigue such as performance. However, the current version relies on good empirical data collected from shift workers over long periods. This software system is currently being used for scheduling purposes by Australian carriers and agencies such as Qantas, the Civil Aviation Safety Authority, and the Australian Transportation Safety Bureau. It is commercially available from InterDynamics (www.interdynamics.com and www.faid-safe.com).

The interface is user friendly and the outputs are easily understood, provided the user has some understanding of fatigue and fatigue risk management. A more detailed discussion of the actual use of this program is found later in this section.

**Sleep, Activity, Fatigue and Task Effectiveness (SAFTE), FAST™, and xsRiskPro**

SAFTE predicts performance effectiveness, a measure that is affected by fatigue and various sleep factors. The software uses the idea of a “sleep reservoir” as a way to model fatigue risk. The reservoir is full when a person is fully rested and at maximum capacity to perform. As time awake increases, the reservoir empties and can only be refilled by sleep. How fast the reservoir refills depends on the quantity and quality of sleep. The software determines overall performance according to time of day (circadian rhythms) and the level of the sleep reservoir.

The model can take into account time zone changes, individual differences such as a tendency to be a night or morning person, and sleep quality.

Originally designed for the U.S. Armed Forces and the U.S. Department of Defense, SAFTE has also been used by the U.S. Department of Transportation to evaluate work schedules for accident risk.

The same developers subsequently created the Fatigue Avoidance Scheduling Tool (FAST) and xsRiskPro, which are commercially available (www.archinoetics.com/FAST and www.fatiguerisk.com). FAST is intended to help managers and individuals design work and sleep schedules that reduce the risk of fatigue and fatigue-induced errors. xsRiskPro was developed to analyze a large number of work schedules to assess their impact on employees’ fatigue levels while on the job.

Originally, SAFTE required the input of actual sleep data (collected using technologies such as an actigraph), but the software now includes a function called AutoSleep that calculates the likely time of sleep from work schedules and circadian rhythms.

Using the work schedules, FAST displays a curve of the change in performance effectiveness over the day, as well as performance zones (displayed as green, yellow
Companies can either use the default set of performance thresholds or set their own. A critical threshold is set at 77.5% of performance, where fatigue is considered to produce a level of impairment equivalent to a blood-alcohol level of .05. The performance zones tell the user at what time during the day performance falls below acceptable thresholds. Like FAID, the FAST interface is accessible and relatively easy to learn, although some understanding of fatigue is required to interpret the results.

**System for Aircrew Fatigue Evaluation (SAFE)**

Developed by QinetiQ for aviation operations, SAFE is used by the UK Civil Aviation Authority (CAA) to evaluate work schedules proposed by airlines. It relies on data collected during laboratory experiments and was further validated and refined with operational data collected during long-haul flights.

Using the work schedules of flight crews, the software shows variations of alertness levels throughout each shift. Alertness levels are colour-coded from green to red to represent the effect of fatigue on performance. The software calculates sleep periods based on rest and duty periods, but also accepts actual sleep data. It can take into account naps and time zone changes, distinguishing between eastward and westward travel.

To calculate alertness levels, the program takes into account time of day (for circadian influences), time since the last sleep period, and sleep propensity – the tendency to fall asleep (propensity is greatest at the circadian low, around 4 a.m.). Outputs require some familiarization. An understanding of sleep and fatigue is necessary to get the most out of this tool.

QinetiQ has also developed another software tool called Integrated Performance Modelling Environment (IPME) that considers time on task – a factor that may contribute to fatigue on duty. SAFE is currently used by QinetiQ to provide expert advice to airlines on schedules and fatigue, but is not currently available commercially. The company is planning a commercial version of the software for late 2008.

**Circadian Alertness System (CAS™)**

CAS is used mostly by the trucking and rail transportation industries. The software extrapolates sleep and wake patterns based on work schedules, and calculates alertness and cumulative fatigue scores for an individual employee or group of employees working a particular schedule. CAS calculates the probability of accidents in operations as a cumulative fatigue risk score for groups of employees over a period of days or weeks.

In predicting alertness, the system can take into account some individual differences, such as a tendency to be a morning or night person, usual wake-up times, sleep length, sleep flexibility, and napping capability. The system does not take into account the effects of jetlag, exposure to light, or sleep inertia.

The developer of the software, Circadian Technologies (www.circadian.com), uses it in its consulting services. The program is not available commercially on its own.
**Sleepwake Predictor**

Based on a three-process model, the software predicts alertness by calculating the level of sleepiness associated with variations in circadian rhythms and time awake (or asleep). This is used to assess the potential for getting restful sleep and for an employee to remain alert during a given time period.

The program evaluates the fatigue and performance effects of work schedules and the risk level associated with each. The program has been used – mostly by researchers – to evaluate schedules for navy, aviation, railway, trucking, nuclear, and military work environments. The program takes into account sleep latency (how long it takes to fall asleep), a factor that varies with circadian rhythms and tends to reduce daytime sleep. It can also take into account changes in time zone, whether an employee tends to be a morning or night person, habitual sleep length, and difficulties sleeping.

The software uses schedules to calculate likely bedtimes (sleep onset) and wake up times (sleep termination) to produce an alertness curve. It indicates the percentage of time where sleepiness levels are above critical limits, providing risk level for a specific schedule.

**Circadian, Neurobehavioral Performance and Subjective Alertness Model and Circadian Performance Simulation Software (CPSS 1.2)**

This software was developed to predict the effect of factors such as working at night and sleeping during the day on circadian rhythms and on performance and alertness. Successive studies have refined this program, improving its ability to predict sleep deprivation, impact of time of day, and the effect of light and phase shifting (jet lag). Despite its strength in predicting fatigue and performance, the software’s features make it of greater interest to researchers than industry. The program requires sleep start and end times as well as light amplitude data across a 24-hour day. The effort required to collect this information makes it less appealing for companies.

The software is not sold commercially but is available on the Internet as part of a software package called Circadian Performance Simulation Software (1.2) (http://dsm.bwh.harvard.edu/bmu/cpss). It requires an advanced understanding of sleep research and prior experience with biomathematical modelling, and its limited interface is intended for use by the research community.

**FAID: Applying a biomathematical model**

This section provides an example of how one of the programs described above can be applied within an FRMS. A trial version of the Fatigue Audit InterDyne (FAID) is available through Transport Canada or directly from InterDynamics (www.faidsafe.com). More detailed instructions on using FAID are provided in the user’s manual included in the software.

**Defining the scores**

FAID assigns fatigue or recovery values to work and break periods based on four factors:

- length of each work or break period
- time of day when the work or break took place
• prior work history of the employee (seven days)
• biological limitations on sleep and recovery

Based on these factors, the software analyses planned or actual work schedules to provide a score that reflects fatigue likelihood for each shift. This score can then be compared to the scores of other shifts or schedules, or against a threshold value established by the company. For example, a standard work week of Monday to Friday, 9 a.m. to 5 p.m., scores approximately 40. A standard week of night shifts, from 11 p.m. to 7 a.m., produces a moderate fatigue score of about 80.

A recent study suggests that scores between 80 and 100 (high fatigue likelihood) are comparable to the level of fatigue-related impairment caused by staying awake for 23 to 24 hours following a regular work week. Multiple studies have shown that performance impairment at such a level of sleep deprivation is comparable to blood-alcohol concentration over 0.05%.

Risk assessment process

Organizations should try to ensure that work schedules never produce more than a moderate level of operational fatigue. However, a risk management approach can provide some additional flexibility. Depending on the task risk and the fatigue mitigation strategies in place, a company may be comfortable accepting a higher fatigue likelihood threshold. Conversely, if certain tasks carry a particularly high risk, organizations may be more comfortable using a more conservative, lower fatigue likelihood threshold. These decisions should be made using formal risk assessment processes. For a more detailed discussion, please see Developing and Implementing a Fatigue Risk Management System, TP 14575E.

FAID compliance table

With the information gathered during the risk assessment, FAID can be used to review work schedules for adequate sleep opportunity. Start by establishing risk-based FAID threshold values to define “acceptable,” “questionable,” and “unacceptable” fatigue likelihood scores. The upper threshold (Y) is the limit beyond which the sleep opportunity is insufficient and is likely to result in unacceptable fatigue-related risk. A lower threshold (X, which is typically 10 to 20 points below the upper threshold) is then assigned. FAID scores between the upper and lower thresholds fall into the “questionable” zone, and scores below the lower threshold are “acceptable”.

Schedules should be assessed in advance, and actual hours worked should be assessed afterwards. At least 97.5% of scheduled hours and 95% of actual hours should fall within the “acceptable” zone (below X, the lower threshold). A small percentage of the schedule may fall in the “questionable” zone (between X and Y), but organizations should not intentionally schedule work with scores in the “unacceptable” zone (above Y). Unforeseeable circumstances may sometimes dictate that some part of actual hours worked falls into the “unacceptable” zone (up to 1.25% of total hours worked), but all work in zones other than “acceptable” should be investigated and appropriate corrective action taken where necessary.
The principle of this compliance table can be used with other scheduling software that calculates scores that can be used as thresholds for fatigue-related risk.

Using FAID

On opening the program, first-time users are taken through an introduction to the software and its use. Regular users go directly to the inputs menu. The menu at the top of the screen (shown below) shows users where they are in the analysis process.

Fatigue tolerance levels (FTL) for various types of tasks are established through a task fatigue risk assessment. Users can select “no fatigue tolerance level, “one tolerance level, or “multiple tolerance levels.” If “no fatigue tolerance level” is selected, the software will produce only fatigue scores in the Outputs display without comparing them to a tolerance level.

A graph (see following figure) shows the changes in compliance over time of each employee and the overall work schedule with fatigue tolerance levels ranging from 0 to 100.
For an FTL set at 80, overall compliance is approximately 99%.

Setting the fatigue tolerance level

Users select the fatigue tolerance level (1), and enter the level in the table cell (2). The “save” button (3) is used to keep the FTL for future use.

The FTL chosen is displayed in the bottom window throughout the program (4).

Studies suggest that FAID scores below 80 are broadly consistent with a safe system.
of work and scores above a 100 are broadly consistent with an unsafe system of work. These scores have been independently scrutinized and accepted as evidence in accident investigations by agencies including the Australian Transportation Safety Bureau and the Special Commission of Inquiry into the Waterfall Rail Accident near Sydney, Australia.

Work schedules can be entered by selecting (5) (for the first work schedule), and either opening an existing file (6), pasting schedules from a Microsoft Excel file (7), or manually typing them in.
Maximum FAID score thresholds can be entered in the far right hand column of each shift (9).

Once the data has been entered, use the Wizard button (10), check that the date and length of the work schedule are correct, then click Analyse (11).

Once the analysis is complete, a summary of the results is displayed.
When one or multiple fatigue tolerance levels have been set, the Indicative Fatigue Assessment Results screen displays the compliance level (the percentage of time employees worked when their fatigue was below the FTL) of the schedule. The software also displays the number of hours of worked and how much time was spent in the various fatigue zones (FAID Green, Yellow, and Red Conditions).
The software can also display the results for each work period of the work schedule. Click the Work Schedule 1 button (12) and the program displays the work schedule along with additional information about the degree of fatigue likelihood. The FAID Condition Red column (13) shows the time worked by an employee above the FTL. The Peak FAID Score column (14) shows the fatigue likelihood score for each work period.
Clicking the Key Risk Indicators (KRI) button (15) displays overall and individual summaries, such as compliance with FTL and peak FAID condition, based on the thresholds entered on the input screen.
Individual work periods can be examined using the FAID Score Plot button (16). Each line on the graph represents an individual employee, coloured to represent the peak FAID condition. Each spike on the graph represents a single work period, and the corresponding fatigue likelihood score.
A Gantt chart (17) can be used to examine overall trends in the data, such as seasonal variations or specific employees who have exceptionally high fatigue likelihood scores. Each row on the Gantt chart represents an individual employee, and each square represents a single shift.
CHAPTER 3

Manual Fatigue Audit System

Overview

For organizations with relatively simple schedules or that may not want to invest in software, manual calculations can also be performed to generate scores that provide an indication of fatigue likelihood. A fatigue likelihood scoring matrix uses five scheduling parameters to predict sleep opportunity. These can be used to estimate the degree of work-related fatigue produced by a given schedule:

1. **Total number of hours worked in a seven-day period.** Not surprisingly, as total hours worked increases, sleep opportunity decreases.

2. **Maximum length of an individual shift.** As the length of a given shift increases, the subsequent sleep opportunity decreases.

3. **Minimum length of a short break.** A short break is defined as a single sleep opportunity between work periods. It is typically shorter than 32 hours. Not surprisingly, as the break between shifts decreases, so does sleep opportunity.

4. **Total number of hours worked between 9 p.m. and 9 a.m. in a seven-day period.** This parameter takes into account late finishes, early starts, and night work. All of these will reduce night sleep opportunity and result in a significant reduction in total sleep opportunity.

5. **Frequency of long breaks.** A long break is defined as a period of two night sleeps with a non-working day in between. Long breaks typically provide a significant opportunity to recover from sleep loss accumulated over a sequence of work periods. A schedule can be scored on each of the five parameters using the following table.
Fatigue Likelihood Scoring Matrix for Work Schedules

<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Total hours per 7 days</td>
<td>≤ 36 hours</td>
<td>36.1 – 43.9</td>
<td>44 – 47.9</td>
<td>48 – 54.9</td>
<td>55+</td>
</tr>
<tr>
<td>b) Maximum shift duration</td>
<td>≤ 8 hours</td>
<td>8.1 – 9.9</td>
<td>10 – 11.9</td>
<td>12 – 13.9</td>
<td>14+</td>
</tr>
<tr>
<td>c) Minimum short break duration</td>
<td>≥ 16 hours</td>
<td>15.9 – 13</td>
<td>12.9 – 10</td>
<td>9.9 – 8</td>
<td>≤ 8</td>
</tr>
<tr>
<td>d) Maximum night work per 7 days</td>
<td>0 hours</td>
<td>0.1 – 8</td>
<td>8.1 – 16</td>
<td>16.1 – 24</td>
<td>24+</td>
</tr>
<tr>
<td>e) Long break frequency</td>
<td>≥ 1 in 7 days</td>
<td>≤ 1 in 7 days</td>
<td>≤ 1 in 14 days</td>
<td>≤ 1 in 21 days</td>
<td>≤ 1 in 28 days</td>
</tr>
</tbody>
</table>

The points for each parameter are added up to provide a score between 0 and 40 that indicates the degree of sleep opportunity provided by the schedule. Schedules with a lower score offer a greater sleep opportunity. The figure below shows several schedules scored using this approach.

Fatigue Likelihood Score

[Diagram showing different work schedules with corresponding Fatigue Likelihood Scores]
Examples of different schedules scored using the Fatigue Likelihood Scoring Matrix

**Example 1**

<table>
<thead>
<tr>
<th>Day</th>
<th>Description</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Morning</td>
<td>0500</td>
<td>1400</td>
</tr>
<tr>
<td>2</td>
<td>Morning</td>
<td>0500</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>Afternoon</td>
<td>1330</td>
<td>2230</td>
</tr>
<tr>
<td>4</td>
<td>Afternoon</td>
<td>1330</td>
<td>2230</td>
</tr>
<tr>
<td>5</td>
<td>Off</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>6</td>
<td>Night</td>
<td>2200</td>
<td>0600</td>
</tr>
<tr>
<td>7</td>
<td>Night</td>
<td>2200</td>
<td>0600</td>
</tr>
</tbody>
</table>

Using the five parameters, this schedule would be scored as follows:

1. The total number of hours worked during the seven-day work period is 52 (4 points).
2. The maximum shift duration is 9 hours (1 point).
3. The minimum time off between shifts (short break) is 15 hours (1 point).
4. The total hours of night work scheduled for the seven-day period is 23. This includes 4 hours on each of the morning shifts due to the early shift starts, 1.5 hours on each of the afternoon shifts due to the late finish, and 8 hours on each of the night shifts (4 points).
5. The long break frequency is 1 day within the 7 days of the schedule before the individual starts the night shift on Day 6 (0 points).

The total score for the above schedule is 10 points.

**Example 2**

<table>
<thead>
<tr>
<th>Day</th>
<th>Description</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Day</td>
<td>0600</td>
<td>1400</td>
</tr>
<tr>
<td>2</td>
<td>Day</td>
<td>0600</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>Off</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>4</td>
<td>Afternoon</td>
<td>1400</td>
<td>2300</td>
</tr>
<tr>
<td>5</td>
<td>Afternoon</td>
<td>1400</td>
<td>2300</td>
</tr>
<tr>
<td>6</td>
<td>Afternoon</td>
<td>1400</td>
<td>2300</td>
</tr>
<tr>
<td>7</td>
<td>Night</td>
<td>2300</td>
<td>0600</td>
</tr>
</tbody>
</table>

Using the five parameters, this schedule would be scored as follows:

1. The total number of hours worked during the seven-day work period is 50 (4 points).
2. The maximum shift duration is 9 hours (1 point).
3. The minimum time off between shifts (short break) is 15 hours (1 point).
4. The total hours of night work scheduled for the seven-day period is 19. The employee works 3 hours on each of the morning shifts due to the early start, 2 hours on each of the afternoon shifts due to the late finish, and 7 hours on the night shift (4 points).
5. The long break frequency is 1 day before the individual starts the afternoon shift on Day 4 (0 points).

The total score for the above schedule is 10 points.
Summary

Any work schedule can be run through this scoring system. For example:

- Monday to Friday, 9 a.m. to 5 p.m. (40 hours) receives a score of 1
- Monday to Friday, 3 p.m. to 11 p.m. (40 hours) receives a score of 3
- 4 days on – 4 days off (2 days from 6 a.m. to 6 p.m., 2 days from 6 p.m. to 6 a.m., for a total of 48 hours) receives a score of 14
- Monday to Friday, 6 a.m. to 6 p.m. (60 hours) receives a score of 16
- 7 night shifts of 12 hours, 9 p.m. to 9 a.m. (84 hours), followed by 7 days off receives a score of 22

Based on a company’s risk assessments, managers can consider whether existing work schedules produce acceptable levels of fatigue-related risk.
CHAPTER 4

Conclusion

Beyond Level 1 controls

The software described in this document is intended help managers analyse work schedules for potential fatigue-related risk. However, using appropriate scheduling practices is only one component of an effective a fatigue risk management system. There will always be occasions when employees, intentionally or unintentionally, fail to get enough sleep. Even with sufficient sleep, fatigue-related symptoms can still occur if employees get poor quality sleep or have an undetected sleep disorder.

Under the five-level model of fatigue risk management that is at the heart of this toolbox, companies also need controls to determine whether employees are getting enough sleep (Level 2) and to detect fatigue-related symptoms on the job (Level 3). Organizations also need a process to deal with fatigue-related errors or incidents (Levels 4 and 5) to identify potential incidents, to learn from mistakes, and to check the effectiveness of previous levels of control.

A system with little or no hazard control beyond Level 1 scheduling tools is poorly defended against fatigue-related incidents.

Shared responsibility for managing fatigue

The responsibility for managing fatigue-related risk in an FRMS is shared between employers and employees. The Level 1 controls outlined in this document address the employer’s responsibility to manage schedule-related causes of fatigue. In Levels 2 to 5, employees are responsible for managing the causes of their own fatigue, and for reporting situations where they observe a fatigue-related risk. The employer is responsible for setting up clear and fair procedures that enable both groups to exercise their responsibilities. Policies and Procedures Development Guidelines (TP 14576E) provides further guidance as well as examples of policies and procedures for appropriate management of fatigue-related risk.
Resources


Fatigue Risk Management System
for the Canadian Aviation Industry

An Introduction to
Managing Fatigue

April 2007
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**Notices**

This report reflects the views of the authors and not necessarily the official views or policies of Transport Canada.

Transport Canada does not endorse products or manufacturers. Trade or manufacturers’ names appear in this report only because they are essential to its objectives.

Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Introduction à la gestion de la fatigue», TP 14572F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adeliade, Australia.

The FRMS toolbox consists of six components:

1. *FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue*, TP 14572E: introductory material intended to raise awareness about fatigue

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4. *FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System*, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. *FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines*, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. *FRMS for the Canadian Aviation Industry: Trainer’s Handbook*, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
Fatigue risk management systems recognize that it’s everyone’s responsibility to manage fatigue risk. Employers should make sure that work schedules give employees adequate opportunities for rest between shifts. In turn, employees are responsible for making sure they use those opportunities to get the sleep they need to be fit for work.

An important part of any fatigue risk management system involves teaching employees and managers about fatigue as a safety hazard and how to better manage their own fatigue. This booklet can be used as an introduction to the more detailed, competency-based training workbook called *Fatigue Management Strategies for Employees* (TP 14573E).

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### Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causes and consequences of fatigue</td>
<td>3</td>
</tr>
<tr>
<td>Strategies to manage fatigue</td>
<td>5</td>
</tr>
<tr>
<td>Maintaining a healthy, balanced life</td>
<td>9</td>
</tr>
</tbody>
</table>
Causes and consequences of fatigue

**What causes fatigue?**

How much sleep we need varies from person to person, but most people need an average of seven to nine hours of sleep a night. If you get less than you need over several days, that lack of sleep will build up into a sleep "debt." Losing two hours of sleep a night for four days can make you as tired as though you lost a whole night’s sleep. The only way to pay back your sleep debt is by getting some additional "recovery" sleep.

The human body runs on a 24-hour clock, programmed to sleep at night and be awake during the day. Working when your body is supposed to be sleeping can make it hard to get good quality sleep. Not only do you not sleep as well, some research suggests that night shift workers can lose one to three hours of sleep per day compared to day shift workers. Six hours of sleep during the day is not the same as six hours of night sleep.

Your body clock also controls your body’s daily cycles, such as hormone production, digestion, temperature, and sleepiness. There are two times during the day when you’re more likely to feel drowsy: in the early morning between midnight and 6 a.m., and in the mid-afternoon.

Your sleep too runs in cycles. Over the course of the night, you move several times from a light sleep to a deep dreaming sleep and back to a light sleep. How long each cycle runs varies from person to person, but it’s usually somewhere from 60 to 90 minutes. It’s the deepest sleep that you need to recover best from fatigue.

It is not true that we need less sleep as we get older - we simply have more trouble getting what we need.

Beyond not getting enough sleep, feelings of fatigue can also be brought on or made worse by conditions in your workplace. High-pressure demands, long shifts, stress, and even things like poor lighting, constant noise, and poor weather can make you feel more tired. Not taking breaks during your shift will also increase your feelings of fatigue.

Balancing the demands of shift work with your family and social life can also be stressful and make it hard to get the sleep you need to be fit for duty.
Consequences of fatigue

Being fatigued can have an effect on many aspects of your life. Many people suffer from mood swings, which can hurt your relationships at work and at home. Some people gain weight. Others find it harder to get motivated at work or at home. You can become frustrated trying to balance the need for more sleep with the need to spend time with friends and family. Many people who work shifts feel socially isolated, which only adds to the stress and overall feeling of fatigue.

In the long term, shiftwork can lead to more serious health problems, such as heart disease or gastrointestinal problems such as ulcers.

On the job, fatigue can be a serious safety hazard. Research has found that losing just one night of sleep can impair your performance almost as much as having too much alcohol to legally drive. Your reaction time is slower, you have trouble concentrating or remembering things – you may even fall asleep on the job. There’s a much greater risk that you’ll make a safety-critical mistake. Being fatigued can make you a risk to yourself, your co-workers, and even the public.

It’s not just at work that being fatigued can be dangerous. There’s a real risk that you’ll fall asleep at the wheel while driving home after a long shift.

<table>
<thead>
<tr>
<th>Consequences of fatigue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individuals</strong></td>
</tr>
<tr>
<td>Increased sleepiness</td>
</tr>
<tr>
<td>Increased risk of</td>
</tr>
<tr>
<td>accident</td>
</tr>
<tr>
<td>Increased stomach</td>
</tr>
<tr>
<td>upsets</td>
</tr>
<tr>
<td>Decreased motivation</td>
</tr>
<tr>
<td>Mood swings or</td>
</tr>
<tr>
<td>depression</td>
</tr>
</tbody>
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Strategies to manage fatigue

**Get a good night's sleep**

To help your body get ready to sleep, keep to a regular routine. Doing little things like brushing your teeth every day in the same order before bed can train your body to associate them with bedtime and sleeping, even if it’s daytime and your body is normally awake.

Spend a few minutes winding down before bed. A little light exercise can sometimes help, although avoid anything strenuous at least an hour before trying to fall asleep.

Your body is programmed to digest food best during the day, so it’s better not to eat a big meal just before bedtime. A light snack may be okay. Avoid anything with caffeine, such as coffee or energy drinks. Alcohol is not a good idea either, because you won’t sleep as deeply and won’t wake up feeling as refreshed.

Make your bedroom as comfortable a place to sleep as possible. Because light makes your body think it’s time to wake up, your room should be dark. And not too warm – somewhere between 18°C and 24°C is a good temperature for sleeping.

Some fresh air can help as well. Try to use your bedroom only for relaxing, sleeping, and sex. Move potential distractions such as televisions and computers to another room.

Make sure you won’t be disturbed. Use an answering machine for the telephone. If there are children around, make sure they won’t wake you – tell your family about your schedule and put a sign on your fridge or bedroom door. If noise is keeping you awake, try using ear plugs. Because noise can sometimes disturb your sleep without actually waking you, some people use “white noise,” such as a fan or an untuned radio, to help dampen other sounds.

If you can’t get to sleep, it’s sometimes better to get up and do something relaxing instead of tossing and turning. Try reading or taking a bath.

If your work schedule changes, try changing your bedtime by an hour or two each day to get your body gradually used to your new shift.
Talk to your doctor. More information on sleep disorders is available on the Canadian Sleep Society’s website (www.css.to), which also includes a list of sleep medicine clinics in Canada.

Use drugs intelligently

Caffeine is one of the most widely used drugs in our society. Many people use the caffeine in a strong cup of coffee or tea to get their day started and to fight off feelings of fatigue as the day wears on.

Caffeine is also found in cola drinks, such as Pepsi or Coke, and in energy drinks such as Red Bull. You can also buy caffeine pills such as No-Doze. Keep in mind that you can develop a tolerance to caffeine – if you drink coffee regularly, you may need more than a cup to keep you alert when you’re really fatigued. You can also develop a dependence. Many people develop withdrawal symptoms such as headaches when they try to go without.

The sugar in caffeinated drinks can actually work against the stimulating effect of the caffeine and reduce your alertness after the initial effect wears off.

Remember that stimulants only hide or postpone the effects of fatigue. They do not replace the need for sleep.

Some people use alcohol to help them relax before bedtime. While a couple of drinks may help you fall asleep more easily, alcohol tends to disrupt your sleep cycle and often produces a light, restless sleep that leaves you less refreshed.

Take a nap

While a nap is no substitute for a good night’s sleep, it can help you recover from fatigue and make you feel refreshed. How long you should nap depends on how much time you have available. You’ll feel more refreshed if you wake up naturally at the end of a sleep cycle. However, a nap should be at least 10 minutes long.

Remember that when you wake up, you may feel groggy and disoriented for about 20 minutes. This is especially true if you’re wakened by an alarm instead of waking up naturally, or if you awaken from a particularly deep stage of sleep. This is known as sleep inertia. If you’re planning a nap, make sure you build in time to properly wake up before taking on anything that requires full concentration, such as driving.

Although it doesn’t seem to matter what time of day you take a nap, it’s easiest to fall asleep when your body is most tired mid-afternoon and between midnight and 6 a.m.

Sleep disorders

If you don’t feel refreshed despite getting lots of sleep, or if you have ever been told that you stop breathing in your sleep or that you wake with a choking noise, you may suffer from a sleep disorder. Other warning signs include heavy snoring, restless legs, and sudden "sleep attacks" during the day. Sleep disorders disrupt your sleep, leaving you fatigued and unable to concentrate. Over time, they can lead to serious health problems.
There are a variety of over-the-counter and prescription sleeping pills available to help you get to sleep. However, like caffeine, your body can develop a tolerance and a dependence. After about a week, you may have difficulty falling asleep without them. Over time, you may need a larger and larger dose to fall asleep. Sleeping pills are best used occasionally or for only a few days at a time.

Stay alert at work

As well as getting the sleep you need, there are other ways to make sure you’re wide awake and alert when you need to be.

Take regular breaks. Don’t take your coffee or lunch break at your work station. Get up, walk around a little, get some fresh air. A change of scene can help you relax for a moment and leave you feeling more awake and energized.

Eat properly. Snack bars or sugary foods can give you a rush of energy—a sugar high—but that’s usually followed by a low that makes you feel tired again. Foods like potatoes, pizza, and white bread have a high glycemic or sugar index and can make you feel sluggish. It’s better to eat a sandwich on brown bread, which will keep you going longer without getting tired. Foods with a low glycemic index include low-fat yogurt or cottage cheese, lean beef and chicken, and canned fish packed in water.

Stay hydrated. Not drinking enough can make you feel sleepy. But be careful what you drink—drinks that contain caffeine or alcohol can actually make you more dehydrated. Sugary drinks or fruit juices can make you feel more thirsty. It’s often said that you should drink about two litres of water per day. You should pay particular attention if you work in a hot,

Stay fit and healthy

Regular exercise helps you sleep well, stay healthy, and feel fit. It may not be easy to find a regular time to exercise if your work schedule keeps changing, but you don’t need to join a gym or a local sports team to enjoy the benefits of exercise. Even going for regular walks can help improve your energy levels and stamina, reduce the risk of heart disease and other health problems, and help you feel better and sleep better.

An Introduction to Managing Fatigue
dry, or air-conditioned environment. Or if your job is physically demanding and makes you sweat. Eating high fat or high salt foods can also make you dehydrated.

*Make smart use of caffeine.* Coffee, tea, colas and energy drinks can help you stay alert. Just remember that the more regularly you use them, the more you will need if you really need help staying alert.

**If you start to feel sleepy at work...**

Research has found that we’re not very good judges of how sleepy we are. In fact, the more tired we are, the less able we are to judge our own levels of fatigue. If you find yourself constantly yawning, your thoughts keep wandering, you suddenly realise you haven’t been concentrating, your eyes close for a moment or go out of focus, and you have trouble keeping your head up, you have all the danger signs of being drowsy.

Take a break, if you can. Or a nap, if possible. Try rinsing your face with cold water. Have a sandwich and something to drink. Don’t start work again until you feel fully alert.

If you can’t take a break, you could try the usual tricks such as opening a window or drinking a cup of strong coffee. These may help for a while, but they are not dependable strategies.

**Be careful on the drive home**

One of the most dangerous things you can do when you’re fatigued is drive to or from work. Depending on your shift, you may be driving during the very times that your body most wants to sleep.

You could have a coffee before leaving work, but remember it may affect your ability to get to sleep when you get home. You could also have a nap before you leave work, but don’t forget about the effects of sleep inertia. Be careful to wait until you’re fully awake before getting behind the wheel. Drive carefully, don’t speed to get home faster, and don’t be shy about stopping to take a break or nap if you find yourself feeling sluggish.
Maintaining a healthy, balanced life

Get enough sleep

Managing your fatigue does not mean you should spend all your time away from work trying to sleep. At the same time, it can be tempting to give things like family responsibilities, going out with friends, or even watching TV a higher priority than sleep.

Many people who work shifts feel socially isolated. They work while friends and family are socializing. Friends may stop calling because they assume you’re not available. This can be frustrating, which can affect your overall health and get in the way of being well rested.

Remember that it’s your responsibility to get enough rest to be fit for work. And don’t forget that you need to be rested to fully enjoy your family and social time.

Spend time with friends and family

Finding the right mix of work, sleep, and family and social time can be a real balancing act. It may mean that you have to plan your time more carefully, and make more of an effort to stay in touch with friends. Let your family and friends know your work schedule. Try to plan events well in advance. You may have to organize activities yourself, rather than waiting for others to include you.

It’s possible, too, that your work schedule allows you to participate in school or community activities that other working people aren’t able to. Try exploring volunteer activities as a way to maintain contact.

Finding time for intimacy in your relationship may be difficult too. You may have to plan ahead – make a date for sex. Or you may have to learn to be more spontaneous. Whatever the best solution for you, be aware that you may have to make an effort for you and your partner to adjust to your work schedule.

Enjoy time for yourself

Some people report that working shifts leaves them a lot of time by themselves. This isn’t a bad thing, if you can use it doing things you enjoy. Take advantage of the fact you don’t need to compromise or...
Fatigue Risk Management System for the Canadian Aviation Industry

negotiate for time alone to relax, enjoy a hobby, plan a trip or event, get some exercise – or even catch up on some much-needed sleep!

**Stay fit and healthy**

Research has found that a higher percentage of shift workers suffer from a variety of health problems than the general population. Aside from being more likely to feel fatigued, they’re more likely to report difficulties sleeping, mood changes such as depression, gastrointestinal problems like ulcers, heart disease, nutritional problems that can result in weight gain or loss, and even reproductive problems such as miscarriages or difficulty getting pregnant. One study suggests that over the long term working shifts may shorten your life by as much as five years.

Taking care of your health can combat these problems. Get regular exercise and eat a nutritionally balanced diet. Learn to relax, manage your fatigue, and get the sleep you need. Pay attention to your overall health and visit your doctor regularly.
Fatigue Risk Management System
for the Canadian Aviation Industry

Fatigue Management Strategies for Employees

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Notices

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Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Stratégies de gestion de la fatigue pour les employés», TP 14573F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adelaide, Australia.

The FRMS toolbox consists of six components:

1. **FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue**, TP 14572E: introductory material intended to raise awareness about fatigue

2. **FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees**, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. **FRMS for the Canadian Aviation Industry: Employee Training Assessment**, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. **FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System**, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. **FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines**, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. **FRMS for the Canadian Aviation Industry: Trainer’s Handbook**, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
Contents

Introduction .................................................................1
  Why a training program on fatigue risk management? ...............1
  What is the purpose of this workbook? .................................1
  How to use this workbook? .............................................2
  Will this program be assessed? ........................................2

1. Working Non-Traditional Hours ....................................3
   Living in a 24-hour society .........................................4
   Body clock (circadian rhythms) ....................................5
   Performance ............................................................5
   Individual differences ..............................................6

2. Fatigue .................................................................7
   What is fatigue? .......................................................8
   Symptoms of fatigue ...............................................9
   Consequences of fatigue ...........................................11
   How big a risk is fatigue? ..........................................11
   High risk times for fatigue ........................................11

3. Sleep .................................................................13
   What is sleep? ........................................................14
   Recovery sleep .......................................................16
   Age and sleep .......................................................17
   Setting up your bedroom ...........................................18
   Insomnia ..............................................................19
   Case study ............................................................20

4. Napping .............................................................21
   The benefits of napping ............................................22
   Sleep inertia ..........................................................23
Why a training program on fatigue risk management?

Transport Canada is committed to improving aviation safety through the management of fatigue-related risks. To this end, a set of tools was developed to support the Canadian aviation industry in implementing Fatigue Risk Management Systems (FRMS) within Safety Management Systems.

An important part of an FRMS consists of training all employees in the management of fatigue as a safety hazard. To achieve this goal, the tools developed include various training materials that are designed to meet the business needs of participating organizations and the skills development needs of their employees in relation to fatigue risk management.

Managing human resources has always been a demanding task and now more than ever industry must acknowledge the unique needs of employees who work outside the Monday-to-Friday, 9-to-5 schedule. Non-traditional work schedule designs have benefits for employers and employees. But decisions made without thorough knowledge of the safety and family or social impacts of such hours could result in shift patterns that compromise any potential benefits. Appropriate and efficient management of the workforce is crucial to meeting the demands of the Canadian Aviation Regulations, as well as ensuring high levels of work site productivity.

What is the purpose of this workbook?

This workbook aims to provide the knowledge and skills to help you to adopt appropriate fatigue management strategies.

More specifically, you will learn how to:

- monitor potential causes of fatigue and devise action plans to minimize their effects in accordance with company procedures;
- identify personal warning signs of fatigue and appropriate countermeasures in accordance with workplace procedures to ensure that effective work capability and alertness are maintained;
• make positive lifestyle choices to promote the effective long-term management of fatigue;
• adopt and apply effective practices and countermeasures for combatting fatigue; and
• communicate your personal fatigue management strategies to relevant people.

**How to use this workbook?**

This workbook involves a combination of theory and practical strategies related to both work and non-work situations. This study guide will be your reference during your training.

Each chapter begins with a list of learning outcomes. These are provided to organize the training around clearly defined outcomes that students are expected to demonstrate on completion. The content of each chapter includes background information on the featured topic and related practical strategies to minimize the effects of non-traditional work hours and fatigue. Topics covered include sleep, nutritional, physical, social, and work design strategies to minimize the risk of fatigue.

Exercises are provided throughout the workbook. Students are asked to demonstrate they can apply the knowledge learned to everyday situations by completing the exercises provided in each chapter. Knowledge checks are also included at the end of each chapter to allow students to verify whether they need to review some of the content.

**Will this program be assessed?**

Depending on the training format chosen by your company, you may have to complete an assessment to receive a certificate of completion for this course. Your trainer or supervisor will inform you whether an assessment process will be used and its exact format. An assessment can take various forms, including:

• If your training program includes classroom delivery for this course, the assessment could include group and case study exercises (written and oral) to reinforce the course content.
• By completing the exercises in each chapter of the workbook, you may demonstrate that you are able to apply this learning to your individual work situation. This may be endorsed by the assessor or your supervisor.
• You may be asked to complete an assessment exercise to show that you have retained knowledge and acquired skills from this training. This involves answering questions on the content of this workbook (similar to the exercises and knowledge checks).
• Skill achievement may also be demonstrated through maintaining a candidate’s log. This process requires you to record how you have applied the skills learned during the course in your specific work situation and daily life.
CHAPTER 1

Working Non-Traditional Hours

Learning Outcomes

After reading through this chapter, you should be able to:

• Explain positive and negative impacts that non-traditional hours of work can have on you.
• Identify individual differences that influence the capacity to adapt to non-traditional hours of work.
Living in a 24-hour society

We live in a 24-hour society where many different work patterns have developed beyond the traditional Monday-to-Friday, 9-to-5 routine. An increasing proportion of the workforce is engaged in shift work and non-traditional schedules. Between 15 and 30% of the workforce of industrialized countries is engaged in shift work. In Finland, 25% of the working population are shift workers, while in Singapore that figure is closer to 32%. In Canada, approximately 30% of workers are employed in some form of shift work.

Working shifts work or non-traditional hours involves more than just a work schedule. It is a way of life with a fundamental impact on not only work, but sleep patterns and the management of health, family, and social lives. Research also indicates that shift work affects physical and mental health, as well as work performance.

EXERCISE

What are some of the personal difficulties that you or some of your co-workers have experienced as a result of shift work or non-traditional working hours?

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Fatigue Risk Management System for the Canadian Aviation Industry
Fatigue Management Strategies for Employees

themselves trying to sleep and eat at times when their body is not programmed to do so. This is why, in the long run, shift workers are more likely to experience fatigue due to sleep disruption and gastrointestinal problems.

Performance

Work hours influence a person’s ability to perform in a given situation. Other factors play a role as well, such as the type of task to be performed, motivational effects, individual differences among workers, and how well workers adjust to changes in routine. Unlike health effects, deterioration in performance can occur very soon after beginning to work certain hours. The negative effects on performance can be worse in jobs that require sustained attention, extended hours, or high-risk tasks.

Can you think of positive and negative effects of these work hours on health, lifestyle, safety, or well-being?

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<th>Positive effects</th>
<th>Negative effects</th>
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<tbody>
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Some shifts (such as night shifts) are more likely to be harmful to health than others (see Chapter 15 for the different types of shifts and their impact on the worker). The effects of a particular shift depend on when it falls within a 24-hour period and the disruption it causes to your body clock.

**Body clock (circadian rhythms)**

One of the most predictable environmental variations to which the body must respond is the cycle of night and day. This cycle relates strongly to why we feel sleepy at night and awake during the day. Many body rhythms, such as sleepiness and wakefulness, secretion of digestive enzymes, hormone production, and body temperature operate on a 24-hour cycle. These are called circadian rhythms.

These normal biological rhythms do not adjust easily to a pattern imposed by work schedules unless the schedule is day work. On the whole, most people find working at night more difficult than working during the day. This is because these schedules are more likely to disrupt sleep/wake patterns and other biological rhythms. People find themselves trying to sleep and eat at times when their body is not programmed to do so. This is why, in the long run, shift workers are more likely to experience fatigue due to sleep disruption and gastrointestinal problems.
Individual differences

The impact of a schedule varies from one person to another. Exercising, eating a balanced diet, having good sleeping habits, and using effective time management strategies are all behaviours that help in better coping with shift work. More information is provided in the following chapters on how these factors can reduce the impact of shift work.

Coping with shift work and fatigue becomes increasingly difficult with age. This is in part because the body's physiological systems become gradually less able to adapt. However, as we age, our past experiences and the strategies we have developed to manage and cope with the demands of non-traditional work hours may help to counter some of the physiological effects of aging.

The ability to cope with shift work also depends on an individual characteristic related to circadian rhythms. People can be categorized either as morning or evening types depending on the moment of the day when they perform at their best. Morning people will better adapt to early morning hours but will have more trouble coping with night work. Evening types cope more easily with evening and night shifts. They tend to cope better with shift work overall since they generally have less rigid sleep habits and find it easier to catch up by sleeping late in the morning.

Knowledge Check

- Name three aspects of your life that can be affected by non-traditional hours of work.
- Name two types of biological rhythms that are regulated by the body clock.
- Name three personal characteristics that influence the impact of non-traditional hours of work on a person.
Learning Outcomes

After reading through this chapter, you should be able to:

- Describe what fatigue is.
- Name factors that contribute to fatigue.
- Identify signs of fatigue.
- Name the times of day when fatigue is at its highest level.
**What is fatigue?**

Fatigue is an experience of physical or mental weariness that results in reduced alertness. For most people, the major cause of fatigue is not having obtained adequate rest or recovery from previous activities. In simple terms, fatigue largely results from inadequate quantity or quality of sleep. This is because both the quantity (how much) and the quality (how good) of sleep are important for recovery from fatigue and maintaining normal alertness and performance. Furthermore, the effects of fatigue can be made worse by exposure to harsh environments and prolonged mental or physical work.

Inadequate sleep (quality or quantity) over a series of nights causes a sleep debt, which results in increased fatigue that can sometimes be worse than a single night of inadequate sleep. A sleep debt can only be repaid with adequate recovery sleep.

Working outside the Monday-to-Friday, 9-to-5 routine can limit the opportunity for sleep and recovery in each 24-hour period. It can reduce the amount of sleep you get by between one and three hours per day. This is because these hours of work:

- limit the amount of time available for sleep
- disrupt the body clock, which is programmed for activity during the day and sleep at night

In addition to sleeping less, people who work non-traditional hours often obtain sleep of a lower quality.

In the current 24 hour, 7 day a week (24/7) society, there are many reasons that workers don’t obtain the quality or quantity of sleep that they require to be adequately rested. Some of these reasons are work related and some are non-work related. Examples of work-related fatigue factors are:

- hours of work (especially night work, early morning starts, and high total number of hours)
- task demands or time pressures that do not allow for adequate breaks during shifts
- working conditions that may compound fatigue (for example, heat stress and time pressures)
Examples of non-work-related fatigue factors include:

- undiagnosed or untreated sleep disorders
- individual family or social factors that take priority over sleep

Identify at least two causes of work-related fatigue that have affected you during your working life.

Symptoms of fatigue

In general, we are poor judges of our own fatigue levels. It’s difficult to tell when our fatigue has reached a point where it’s no longer safe to work or drive. However, there are signs or symptoms that can be used as a gauge.

Fatigue-related symptoms can be divided into three categories: physical, mental, and emotional. The diagram on the following page outlines some of the major symptoms in each category. Depending on the type of work being conducted, there may be some task-specific indicators of fatigue that can be added to this list. If you experience two or more of the symptoms listed, you may be experiencing some level of fatigue or reduced alertness. Fatigue is not the only cause of all the symptoms, but when they occur together it likely indicates fatigue-related impairment.

If you exhibit fatigue-related symptoms on a regular basis, you should consider seeing an appropriate medical specialist. This is particularly important for individuals with a body mass index greater than 30 and a neck size greater than 40 cm, since they have a significantly higher risk of sleep apnea.
Symptoms of fatigue

Physical Symptoms
- Yawning
- Heavy Eyelids
- Eye-rubbing
- Head drooping
- Microsleeps

Mental Symptoms
- Difficulty concentrating on tasks
- Lapses in attention
- Difficulty remembering what you are doing
- Failure to communicate important information
- Failure to anticipate events or actions
- Accidentally doing the wrong thing
- Accidentally not doing the right thing

Emotional Symptoms
- More quiet or withdrawn than normal
- Lacking in energy
- Lacking in motivation to do the task well
- Irritable or grumpy behaviour with colleagues, family, or friends

Circle any of the above symptoms that have significantly affected you in the past. Reflect on these symptoms and indicate how they have affected your work.

________________________________________________________________________
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________________________________________________________________________
Consequences of fatigue

A fatigued individual is often impaired and can’t continue to perform tasks safely or efficiently. For example, fatigue can affect your ability to:

- react quickly in emergency situations
- communicate clearly with fellow employees
- work productively

Fatigue and falling asleep have been identified as significant contributors to incidents and accidents in a wide cross-section of industry. This relationship has been well supported by evidence from organizational and government investigations as well as industrial risk data. The incidents and accidents that result from fatigue can be severe and include fatalities, but are most often associated with employee injury or equipment damage.

How big a risk is fatigue?

In recent years, researchers have compared effects on performance of alcohol and fatigue. While most people understand that alcohol intoxication can be a significant risk on the roads, the effects of fatigue are not generally understood or acknowledged.

Studies have found:

- The performance of a person who wakes at 7 a.m. and stays awake for 17 hours until midnight will be as impaired as that of someone with a blood-alcohol concentration (BAC) of 0.05% – the legal driving limit in many countries.
- A person who wakes at 7 a.m. and then stays awake for 23 hours until 6 a.m. the following day will have a performance as impaired as someone with a BAC of 0.10% – more than the legal limit of 0.08% in Canada.

Although there are differences between being fatigued and being drunk, this research provides valuable information. One night of sleep deprivation can leave you more impaired than would be acceptable for driving a vehicle.

High risk times for fatigue

There are particular times of the day when the risks associated with fatigue are increased, regardless of the relationship between fatigue and recovery sleep. It is important to understand these risks when making decisions about hours of work, hours of overtime, contingency planning, and emergency responses.

Times when fatigue levels increase are:

- midnight to 6 a.m. (and especially 3 a.m. to 5 a.m.). This is the low point in the body’s circadian rhythm that governs alertness and performance.
- the beginning and end of shift when handover occurs. Fatigue levels can affect communication.
- when breaks have not been taken for a number of hours. Employees who have been on duty longer may have accumulated fatigue.
• early shift starts (before 6 a.m.). Early start times shorten sleep obtained the night before if you either neglect to go to bed earlier in compensation, or “clock watch” because you are anxious about getting up on time.
• when employees are new to the job or workplace. Learning the new job and getting to know the environment and personnel is stressful. People may find they do not sleep as well during the first week or so of a new job while they become accustomed to the new workplace, role, commute, and hours.

Describe one or more safety hazards you have witnessed in your work environment as a result of any of the above situations.

Knowledge Check

• What are two major causes of fatigue?
• Name four symptoms of fatigue.
• Compare performance in the following situations:
  - Being awake for over 17 to 23 hours
  - Being under the influence of alcohol
CHAPTER 3

Sleep

Learning Outcomes

After reading through this chapter, you should be able to:

- Describe the general functions of sleep.
- Explain the consequences of sleep deprivation.
- Explain ways of establishing a sleeping environment that can promote your sleep.
Sleep

What is sleep?

Sleep is defined as a state of partial or full unconsciousness during which voluntary functions are suspended and the body rests and restores itself.

Despite the obvious importance of sleep, its specific function is not fully understood. In a broad sense, it is thought that during sleep the mind and the body “recover” from the stresses of the day and “prepare” for those to come. Information about the function of sleep has mainly come from studies depriving animals and humans of sleep.

Prolonged sleep deprivation of animals over two to three weeks resulted in skin lesions, weight loss, and ultimately death. In humans, prolonged sleep deprivation leads to reduced mental and physical performance and symptoms such as hand tremors, slurred speech, and increased sensitivity to pain.

Both the quality and quantity of sleep are determined largely by the timing of sleep in the 24-hour day. Human beings are programmed to sleep during the night and to be active during the day.

Sleep cycles and sleep structure

Sleep varies through the night; it is not uniform. The various sleep stages follow each other in a continuous cycle that lasts between 90 and 120 minutes. Each cycle is composed of five sleep stages. Stage 1 is where we fall asleep. During this stage, you may occasionally experience muscle twitches or starts. Stage 2 is a light sleep stage, when you are easily awakened. Stages 3 and 4 are deep sleep stages. These stages are considered to be those where the body regenerates. People are difficult to waken during these stages. The final stage is known as REM sleep, for rapid eye movement. If you were to observe a person in this stage of sleep, you would notice their eyes moving under their eyelids, and possibly some muscle twitches. This is the stage of sleep when we dream. This stage of sleep is important in learning and in memory consolidation.

Early in the night, we spend more time in stages 3 and 4 of each sleep cycle. As the night progresses, we spend more time in REM sleep. Whenever we are sleep deprived, our body will try first to catch up on deep sleep (stages 3 and 4) and...
REM. A person who is sleep-deprived will quickly fall asleep, and move rapidly from light sleep (stages 1 and 2) to deep slumber (stages 3 and 4).

![The human sleep cycle diagram](image)

Adapted from Shifting to Wellness, Keyano College, 1995.

**The human sleep cycle**

Can you recall any situations where you have suffered from sleep deprivation? Please provide details.

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Fatigue Management Strategies for Employees
Recovery sleep

Unwanted sleepiness and fatigue can be considered an annoyance – and a danger under certain circumstances. It can be fatal, for instance, while driving a vehicle or flying an aircraft.

Many strategies have been identified to reduce the likelihood or consequences of fatigue. Some are discussed later in this workbook, such as the use of caffeine or being more aware of what you eat. More extreme examples include the use of amphetamines and other stimulants. However, such strategies are only a temporary fix, no matter how effective they are. At some stage, sleep must be obtained for physical and mental recovery to occur.

The exact amount of sleep that each person needs every 24 hours to perform optimally differs, but in general it’s between 7 and 9 hours. The need for sleep does not diminish as we get older, even though sleep may prove more difficult to obtain. Most people go to sleep naturally between 10 p.m. and 8 a.m. Older people tend to go to sleep earlier than younger people. Sleep is most valuable if obtained in a single block. However split sleep, or a number of short sleeps, is better than not getting any at all. A short sleep or nap can provide a powerful boost to alertness. However, it is important to know that napping does not eliminate the need for sleep. There are other considerations relating to napping covered in Chapter 4.

Approximately how many hours of sleep do you get (on average) per day?

Is this enough and do you think your performance would improve if you got more sleep per day?
Does the amount of sleep that you normally get vary with the different shifts that you work? If so, please explain.

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**Age and sleep**

As we get older it becomes physically more difficult to stay asleep during a sleep period without waking up. This is particularly true during daytime sleep, but even nighttime sleep may prove to be more difficult as we get older. Falling asleep and poor sleep are not the only age-related changes that make non-traditional hours of work difficult. Recent research suggests that an aging bladder can contribute to sleep disturbances because it causes you to wake up more often to visit the toilet. Along with other age-related changes, this can cause more frequent awakenings across the sleep period. Frequent awakenings can lead to increased sleepiness when you are awake.

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Have you noticed any significant changes in sleep patterns, either in yourself or in an acquaintance, that appear to be related to age? If so, what are they?

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Setting up your bedroom

Obtaining adequate sleep can sometimes be a challenge, even in the most ideal circumstances. From both a biological and social perspective, sleeping during the day can cause the greatest difficulty. This is related to the body’s biological programming to be awake during the day, as well as the fact that it is noisier and brighter during the day. In addition, you may have more pressures on your time during the day. While some of these things are hard to change, you can set up your bedroom to maximize your chances of getting sleep when you have the opportunity.

Things you can do to your bedroom include:

- Block out as much light as possible. This might involve the use of blackout curtains, roller shutters, heavy blinds, or even an inexpensive option such as black plastic.
- Use your bedroom only for sleep, relaxation, and sex. Remove work desks, home offices, computers, and even televisions.
- Control the noise that enters your bedroom. This can be done using physical barriers such as roller shutters, double glazed windows, and insulation, but it can also be managed by simply placing a sign on the door when you are sleeping. Unless you are on call, you should also turn down the telephone so that it does not disturb your sleep.
- Reduce the disruptive noise that enters your bedroom. In addition to the physical barriers listed above, there are other ways that noise can be dampened out. For example, many people have success using a white noise source such as a fan, air conditioner, or relaxing CD on “repeat.” Ear plugs can be of use if you can sleep with them in. They are especially useful if you are sleeping away from home. Many workplaces supply foam ear plugs, and you can buy more solid silicone-based plugs at a drugstore or sporting goods store.
- Minimize caffeine and alcohol intake in the hours before bedtime. Caffeine acts as a stimulant to keep you more awake. The stimulating effects of caffeine can last up to six hours. In addition, both caffeine and alcohol are diuretics, substances that flush water from your body. That is, they make you more likely to wake up to go to the toilet.
- Set up a “thermo-neutral” zone. The body sleeps best when the environmental temperature is between 18 and 24°C. If you are too cold or too hot, your body will wake up to control its temperature more efficiently. A thermo-neutral zone is best set up using good placement of the bedroom in the house, good use of insulation, and using an air conditioner or heater with a thermostat.
- Don’t panic if you can’t get to sleep. Most people have days when they can’t sleep. Staying in bed, trying your hardest to get to sleep is unlikely to help, and may even make sleep more difficult. If you cannot sleep within 30 minutes, get out of bed and do something relaxing instead of staying in bed and being frustrated with yourself.
- Establish a pre-bed routine, including quiet/relaxing activities. Each bed-
Fatigue Management Strategies for Employees

Insomnia generally refers to difficulty falling asleep or staying asleep. A frequent medical complaint, it is the most common type of sleep problem. Rates of insomnia are higher in shift workers and people who work non-traditional hours.

Insomnia is usually defined as being transient (lasting up to one week), short-term (lasting weeks to months), or chronic (lasting longer than three months).

Treatments focus on chronic insomnia because most people experience transient or short-term insomnias several times a year.

There are many potential contributors to insomnia. These include work hours, life stressors, age, and sleep environment. Treatments may involve changes to schedules, habits, and lifestyle. The use of drug treatments is controversial and is most useful for transient or short-term insomnia.

Are there any improvements you could make to the way your bedroom is set up? What are they?

• Consult with your doctor if you suspect – or have been told – that you have a sleep disorder. Signs like making choking sounds or stopping breathing regularly during your sleep are classic symptoms of sleep apnea, a breathing-related sleep disorder that can reduce your capacity to stay awake when you are at work, driving, or engaged in other activities.

EXERCISE
Damien is 51, married and has three grown children. He has spent 18 years working shifts as an aircraft maintenance engineer. He drives 45 minutes each way to work his 12-hour shifts.

Recently, Damien drove off the road on his way home from work at 5:45 a.m. Although it’s normal to be tired after working a night shift, it was the fourth time in the past six months and this time it scared him. He stopped the vehicle, and walked around outside in the cold air before he continued home.

Although he has been avoiding talking to his doctor about a possible sleep disorder, this latest incident was the trigger for Damien to make an appointment. His wife, Tonia, has been telling him for nearly two years to do something because his stories about nearly falling asleep at work or on the way home from work scared her. Damien thought he could avoid an accident, but now realizes that he could hurt himself or others if he does not get help.

**Knowledge Check**

- How could Damien improve his sleep?
- Who should Damien see regarding his sleeping problem?
- On average how many hours of sleep should you ideally get each night?
- How can “white” noise positively affect sleep?
- What room temperature range is most suitable for promoting sleep?
- Explain the positive effect of a pre-bedtime routine.
CHAPTER 4

Napping

Learning Outcomes

After reading through this chapter, you should be able to:

- Discuss the benefits of napping.
- Describe the short-term way that sleep inertia may compromise the benefits of a nap.
The benefits of napping

Short sleeps or naps can deliver most of the benefits of longer sleeps over a shorter time frame. These benefits can include improved short-term memory, increased performance, improved alertness, and improved reaction time. But the benefits of naps do not generally last as long as the benefits gained from longer sleeps.

Naps as short as 10 or 15 minutes can deliver measurable benefits. In general, the longer the nap is, the more beneficial it will be in terms of recovery and improvements in performance.

Some research suggests that the time of day you take a nap also affects its recovery value. Other research suggests that this is not the case and that getting any sleep is much more important than the time the nap is taken. Take naps in the way that you believe best suits you. Keep in mind that a nap can negatively affect your chances of sleeping later that day or night.

Is napping permitted in your workplace? If yes, under what circumstances?

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Is napping a strategy that you could benefit from? If so, how could you apply it?

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**Sleep inertia**

While both long sleep periods and napping are highly beneficial for a wide range of reasons, it is important to understand that your performance and alertness may be impaired for a while after you wake up. Most people experience a period of confusion when they wake or are awakened from sleep. This state is known as sleep inertia and generally lasts between five and 20 minutes. You should minimize activities that would be sensitive to sleep inertia (such as driving) for 20 minutes after waking up.

Exactly how long sleep inertia lasts depends on a number of factors. There is no effective way to eliminate or reduce the effects of sleep inertia. Sleep inertia tends to last longer when you:

- are woken up as opposed to waking naturally from sleep
- wake up or are woken up from deep sleep compared to light sleep – this is more common following longer sleeps than shorter naps
- wake up or are woken up at the low point of the circadian rhythm (generally between midnight and 6 a.m.)
- wake up or are woken up after a nap following a period of sleep deprivation

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**Knowledge Check**

- Explain what sleep inertia is.
- Name two benefits of napping.
CHAPTER 5

Learning Outcomes

After reading through this chapter, you should be able to:

• Describe the glycemic index.
• Distinguish high, intermediate, and low glycemic index foods.
• Explain the impact of these foods on alertness.
• Explain how digestion and hunger are affected by non-traditional hours of work.

Food
CHAPTER 5

Food

Why think about food to manage fatigue?

As discussed elsewhere in this workbook, the ability to stay awake is largely related to whether you have had adequate rest and recovery. However, there are other factors that may contribute to feeling weary, sluggish, and more tired in general. One of these is low blood sugar. Many people underestimate or are unaware of the affect of low blood sugar on their ability to stay alert and safe.

Digestion and hunger

As humans, we are programmed to be awake during the day and asleep at night. Many other processes also follow this pattern, including digestion. Digestion is programmed to be most efficient during the day and much less so at night. This is because digestive juices (stomach acids and enzymes) are mainly secreted during the day.

Food eaten at night is digested at a slower rate. This can often lead to feeling bloated or constipated and can cause heartburn and indigestion. Gastrointestinal upsets are very common in people who eat outside of traditional meal times. These upsets can be worsened by drinking tea, coffee, or alcohol. Research has found that night workers are five times more likely to get peptic ulcers than day workers.

Many people working outside traditional daytime hours also notice that their hunger patterns change and that they get hungry at unexpected times of the day.

Controlling blood sugar with food

Given that non-traditional hours of work affect digestion and hunger, it is not surprising that it is difficult to keep your blood sugar stable under such circumstances. A stable blood sugar level is an important ally in minimizing the ups and downs in energy levels that are common for shift workers.

The belief that snacks loaded with sugar cause a fast rise and fall in blood sugar has been recently disproved. The way blood sugar levels react to different foods is known as the glycemic index (GI) of foods.
High GI foods make your blood sugar levels rise and fall quickly, whereas low GI foods make your blood sugar level rise and fall slowly. High GI foods are ideal when you have been doing physical work or exercise and need energy quickly to recover. Low GI foods are ideal to keep an already stable blood sugar level from becoming too high or low. Low GI foods are also ideal for raising blood sugar slowly and avoiding the fast drop in blood sugar (and energy) that can occur after eating high GI foods. Low GI foods are ideal as regular snacks across a shift to help avoid big changes in your energy levels.

Research into GI foods also holds important implications for people with diabetes. In general, medical practitioners recommend that diabetics avoid high GI foods to help regulate blood sugar levels. But high GI foods can be useful as a pick-me-up for non-diabetics, particularly after physical work or exercise. More often than not, however, low GI foods will be more useful in your day-to-day life.

**Low-fat protein strategies**

Research also suggests another eating strategy for shift workers: evidence shows that eating low-fat protein foods can help you stay awake. This is due to a process involving the amino acid tyrosine and leads to increases in the levels of stimulating chemicals in your body.

<table>
<thead>
<tr>
<th>Examples of high GI foods</th>
<th>Examples of low GI foods</th>
<th>Examples of intermediate GI foods</th>
<th>Examples of low-fat protein foods</th>
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</thead>
<tbody>
<tr>
<td>White or whole grain bread</td>
<td>Oranges or orange juice</td>
<td>Banana</td>
<td>Low-fat dairy products</td>
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<tr>
<td>Cornflakes or Coco Pops</td>
<td>Baked beans</td>
<td>Basmati rice</td>
<td>Cooked and canned fish</td>
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<tr>
<td>Doughnuts</td>
<td>Fruit bread</td>
<td>Rye or high-fibre bread</td>
<td>Lean chicken, beef, or lamb</td>
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<td>Muffins</td>
<td>All bran, porridge, muesli</td>
<td>Full-fat ice cream</td>
<td>Protein shakes</td>
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<td>Hard boiled eggs</td>
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<tr>
<td>White or quick brown rice</td>
<td>Low-fat yogurt</td>
<td>Sugar</td>
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<td>French fries</td>
<td>Lentils</td>
<td>Pineapple</td>
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<td>Rice crackers</td>
<td>Chocolate</td>
<td>Weetabix</td>
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<tr>
<td>Puffed corn or rice cakes</td>
<td>Peanuts or cashews</td>
<td>Flavoured milk drinks</td>
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<tr>
<td>Baked or mashed potato cakes</td>
<td>Noodles or pasta</td>
<td>Sweet corn</td>
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<tr>
<td>Cakes</td>
<td>Apples or apple juice</td>
<td>Soft drinks</td>
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<td>Breakfast bars</td>
<td>Grapes</td>
<td>Cookies</td>
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<tr>
<td>Pancakes</td>
<td>Oat bran or grain bread</td>
<td>Cranberry juice</td>
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Fatigue Management Strategies for Employees
What type of GI foods do you normally consume at work or before work: high, intermediate, or low? Give examples.

Are there any food changes you should consider, based on what you now know about the GI of foods? If so, what are they?

**Where to from here?**

It is likely that at least some of the information in this chapter is new to you. You may have picked up some fresh strategies. Try things for a while and see how they work for you. Keep in mind that you are more likely to notice a difference using these strategies if you apply them when you are tired.

It is also important to maintain a balanced diet. In general, the evidence suggests that a low-fat diet comprised mainly of low and intermediate GI foods along with some good quality protein is most beneficial. In addition, it is important to consider the level of fibre in your diet (from fresh fruit and vegetables) as well as the levels of minerals and salt. The recommended daily salt intake is 3.8 grams per day to replace the amount lost daily through perspiration and to ensure your diet provides sufficient amounts of other essential nutrients. However, any more salt than this can result in high blood pressure, which can lead to stroke, heart disease, or kidney disease.
Case study

Jeff is a 58-year-old maintenance engineer who has been working in the aviation industry since he was 16 years old. His three children are grown up and have their own homes and families. Jeff and his girlfriend Lisa have been together for seven years.

Lisa prepares Jeff’s meals. When he has a night shift, afternoon shift or an early morning shift, she packs whatever they would have eaten had they been together. Jeff cooks his meals in the kitchen at work and often prepares steak and eggs, reheats meatloaf, or roasts pork chops. This is the way things were before Lisa was around, and this is the way they have stayed.

The problem is that in the last few years, Jeff has been getting really bad stomach pains whenever he eats a heavy meal on the night shift. Jeff has only a few more years until he plans to retire and he doesn’t want to change the way he does things now. Jeff’s doctor has been saying that the pains are associated with the type of food that he eats on nights, but Jeff thinks he’ll be okay.

Jeff actually has a serious case of peptic ulcer. It’s unfortunate that Jeff doesn’t listen to his doctor because ulcers can be treated quite easily with diet changes and short-term daily medication.

Knowledge Check

- Why might Jeff experience stomach problems after eating a heavy meal on the night shift?
- What changes might Jeff make to his diet to help reduce his stomach problems?
- Why are low GI foods generally appropriate when working shifts?
- What effect does a stable blood sugar have on energy levels?
Learning Outcomes

After reading through this chapter, you should be able to:

- Explain why being hydrated is important for alertness.
- Name factors that contribute to dehydration.
- Determine whether you are drinking enough water daily to stay hydrated.
Can hydration affect alertness?

As mentioned earlier in this workbook, it is not just sleep that affects your alertness. Examples have been provided related to digestion and food. Similarly, hydration has an affect on your ability to feel alert and be safe.

When your body is low on water, it tries to conserve what you have left. It does this by reducing your activity and making you relax and slow down. When you are relaxed, you have a higher chance of falling asleep. Being dehydrated can also make you feel lightheaded and cause headaches.

Most people do not drink enough water to be fully hydrated. In extreme cases, this can result in medical problems, including kidney problems. In most cases, however, the effects of dehydration are short term and are easily solved by drinking more water.

Contributors to dehydration

The recommended daily intake of water is two litres or eight glasses. Drinking less than this contributes to dehydration. There are other factors that can cause dehydration, even if your daily intake of water is adequate. Some of these factors include:

- Performing physically demanding tasks
- Drinking a lot of caffeinated drinks. Caffeine is a diuretic, a substance that actively flushes water from your body
- Working in hot environments
- Drinking alcohol, which is also a diuretic
- Drinking soft drinks, which may not provide the same degree of hydration as plain water
- Eating foods that are high in salt, which require additional water to be processed through the body
To be as alert and awake as possible, you need to be aware of your water intake. For some people, this may mean doubling their fluid intake or more. Surprisingly, many people find that when they drink more water they feel more alert but don’t go to the toilet any more often – their urine output is simply higher each time.

<table>
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<tr>
<th>EXERCISE</th>
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<th>What sort of fluids do you drink at work?</th>
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<table>
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<th>Approximately how much water do you drink at work?</th>
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<table>
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<tr>
<th>Based on what you have just read, do you think you need to make any changes in your drinking habits? Provide details.</th>
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Case study

Terry is a 52-year-old pilot who has been flying for 24 years. He flies 100 to 110 hours per month at all hours of the day.

A while ago, Terry’s friend suggested that drinking water might help him feel more alert while flying. She also recommended that he think more about when he drinks coffee and alcohol.

Now Terry only drinks coffee when he is really tired. This way he reduces his dehydration from caffeine but still gets its stimulating benefits. Terry also drinks more water now but doesn’t need to go to the toilet any more frequently. Although he was initially sceptical, these new strategies have helped Terry feel more alert.

Knowledge Check

- Why might Terry have to go to the toilet more frequently when he drinks caffeinated drinks?
- What effects do alcohol and caffeine have on water in the body?
- How does water affect alertness?
- On average, what is the minimum amount of water you should drink every day?
CHAPTER 7

Caffeine

Learning Outcomes

After reading through this chapter, you should be able to:

- Explain the effect of caffeine on bodily functions.
- Understand the effect of caffeine on alertness.
- Discuss the effect of caffeine on sleep.
- Name symptoms of caffeine withdrawal.
What is caffeine?

Caffeine is an addictive drug. You may be addicted to caffeine if you feel you cannot function without it and need to consume it every day. Caffeine occurs naturally in many plants including coffee beans, tea leaves, and cocoa nuts. It is also found in an array of food products and beverages such as chocolate and cola drinks.

If you drink caffeinated beverages, you are probably aware that caffeine perks you up. If you are low on sleep and need to remain active, caffeine can make you feel alert by blocking adenosine reception. Adenosine causes blood vessels to dilate and nerve cell activity to slow down, causing drowsiness. After drinking coffee, you may notice that your hands get cold, your muscles tense up, you feel excited, and your heart beats faster.

It takes caffeine approximately 20 minutes to enter your system, and the effects can last up to six hours. You should avoid having your last caffeinated drink too close to bedtime. The stimulant effect may reduce your chance of falling asleep.

Strategic use of caffeine

Most people don’t use caffeine as effectively as they could. They tend to drink it when they are not really tired, which means the stimulating effect doesn’t have much impact. Regular caffeine consumption leads to increased tolerance, which means that over time we get less effect from the same quantity. When you have a high tolerance to caffeine, drinking one or two cups when you are really tired may make little difference to your alertness.

People who are addicted to caffeine often experience withdrawal effects when they stop drinking it. These include a dull headache that lasts from one to five days, irritability, nervousness, restlessness, and sleepiness. In extreme cases, nausea and vomiting have been reported.

To use caffeine more effectively, start by being more strategic about when you drink it. Here are a number of tips on how to use caffeine to its best advantage:

- Avoid drinking caffeinated drinks when you are not tired. The caffeine
will have little effect and will contribute to increasing your caffeine tolerance. Your body will get used to having it and, over time, you will need to drink more to get the same effect.

- Avoid drinking caffeinated drinks in the morning. The early part of the day is a time when your body is waking up naturally and, generally speaking, you will feel more awake as the morning progresses. Using caffeine to speed up the process simply increases your tolerance to it. One exception may be if you have to get up really early in the morning.

- Avoid caffeinated products for a few hours before bedtime. Because caffeine acts as a stimulant, it can make falling asleep and staying asleep more difficult.

- Be aware that caffeine usually gets into your system within 20 to 30 minutes and the noticeable effects last approximately 4 to 6 hours.

- Be aware of how much caffeine is in different foods and drinks (see table below).

- If you do drink caffeinated drinks, increase your water intake to counter caffeine’s diuretic effect. You may have noticed that you need to urinate more frequently when you drink caffeinated drinks.

Most importantly, be strategic: the less caffeine you drink, the more effective it will be when you need to use it to help you stay awake.

### Level of caffeine in common substances

**Coffee (250 ml)**

- Instant 65-100 mg
- Drip 115-175 mg
- Brewed 80-135 mg
- Espresso 100 mg

**Tea (250 ml)**

- Green tea 8-30 mg
- Normal 50-70 mg

**Most chocolate bars**

- Approximately 20-40 mg

**Caffeinated beverages (250 ml)**

- Coke 50 mg
- Jolt 100 mg
- Red Bull 80 mg

**NoDoz, 1 regular strength tablet**

- 100 mg
Review your caffeine intake. Are there any changes you could make to the way you use caffeine on the job?

Knowledge Check

- Why does caffeine lose its ability to improve your alertness if you drink caffeinated drinks regularly?
- Name three tips you can apply to get the maximum benefit from caffeine as a stimulant.
CHAPTER 8

Alcohol

Learning Outcomes

After reading through this chapter, you should be able to:

- Discuss the effects alcohol has on alertness.
- Discuss the effects alcohol has on sleep.
- Explain how alcohol consumption affects performance.
What is alcohol?

Alcohol is known to significantly impair performance at moderate and high levels of intoxication. Alcohol intoxication greatly affects the way you respond and interact with your environment and increases your risk of having an accident.

In many industrialized countries, workplaces require a zero blood alcohol concentration (BAC) for their employees. The Canadian Aviation Regulations demand that air crews not drink alcoholic beverages within eight hours of flying. In most working environments, employers cannot tell employees how much alcohol they are allowed to consume away from work. In order to be well rested and fit for work, you need to understand how alcohol works and how it influences sleep and alertness.

Alcohol is the second most widely consumed drug after caffeine. Alcohol is legal in most countries and is so common that it is easy to forget that it is a drug and that it can be dangerous if not used sensibly.

Alcohol is a central nervous system depressant. In small doses, it can make you feel more relaxed and less inhibited. In larger doses, it makes you drunk and impaired.

Alcohol reduces:
- environmental awareness
- responses to sensory stimulation
- mental functioning
- physical activity.

In high doses, alcohol can produce:
- increased drowsiness
- lethargy
- amnesia
- hypnosis
- anaesthesia

Alcohol intoxication is one of the major causes of road accidents. Most countries have laws restricting people with a BAC above a certain level from driving, working, or operating dangerous equipment. In Canada, a BAC of 0.08% or higher means that driving is prohibited. Many activities in the aviation field have a zero alcohol tolerance.
Accident risk

The table below details the effects of various blood alcohol levels. Alcohol progressively impairs your ability to perform and dramatically increases the risk of accidents.

At a BAC of 0.05 to 0.08%, there is a four-fold increase in the risk of a motor vehicle accident.

At a BAC of 0.10 to 0.14%, there is a six- to seven-fold increase in the risk of a motor vehicle accident.

At a BAC of 0.15% and higher, there is a 25-fold increase in the risk of a motor vehicle accident.

<table>
<thead>
<tr>
<th>Blood Alcohol Concentration</th>
<th>Stages</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.05%</td>
<td>Feeling of well being</td>
<td>Talkative Relaxed</td>
</tr>
<tr>
<td>Above 0.05% to 0.08%</td>
<td>Risk state</td>
<td>Judgment affected</td>
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<tr>
<td></td>
<td></td>
<td>Mood affected</td>
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<tr>
<td></td>
<td></td>
<td>Intense high or low moods</td>
</tr>
<tr>
<td>Above 0.08% to 0.15%</td>
<td>Dangerous state</td>
<td>Slow speech</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unstable balance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blurred vision</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vomiting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sleepiness</td>
</tr>
<tr>
<td>0.20% to 0.40%</td>
<td>Drunken stupor</td>
<td>Heavy sedation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No bladder control</td>
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<tr>
<td></td>
<td></td>
<td>Coma</td>
</tr>
<tr>
<td>0.45% to 0.60%</td>
<td>Shock/Death</td>
<td>Shock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Death</td>
</tr>
</tbody>
</table>
Metabolizing alcohol

On average, a person can metabolize 7 to 10 grams of alcohol per hour. This is about the same as clearing two-thirds of the alcohol in a standard drink from the body through the liver, sweat, breath, and urine.

If you consume more alcohol in an hour than you are able to metabolize, your blood alcohol concentration will increase.

A standard drink

Alcohol concentration is usually expressed as alcohol “proof.” Proof means twice the percentage of alcohol. So, if a drink is referred to as 80 proof this means it contains 40% alcohol.

A standard drink contains approximately 13.5 grams of alcohol. See the table below for examples of standard drink equivalents.

According to the Canadian Health Network, guidelines for low-risk drinking are:

- Drink no more than two standard drinks on any day (see table below).
- Men should limit their weekly total of standard drinks to 14 or fewer.
- Women should limit their weekly total of standard drinks to nine or fewer.
- Drink slowly to avoid getting drunk. For example, wait an hour between drinks. Also, consume food and non-alcoholic beverages while drinking alcohol.

Alcohol and sleep

In small amounts (two standard drinks), alcohol taken close to bedtime can help some people relax and get to sleep easier. However, this is not a recommended sleep strategy, as alcohol can affect the quality of your sleep. In larger amounts (four or more standard drinks), alcohol will help you fall asleep or pass out quickly, but not only will it reduce the quality of your sleep, it will also lead to a more restless and light slumber toward the end of the sleep period. This may cause you to wake up feeling less refreshed.

### Standard drink equivalents

| 341 ml (12 oz) | Regular-strength beer | 5% alcohol |
| 142 ml (5 oz)  | Wine                   | 12% alcohol |
| 85 ml (3 oz)   | Fortified wine         | 18% alcohol |
| 43 ml (1.5 oz) | Spirits                | 40% alcohol |
The costs associated with alcohol abuse in the workplace include:

- Increased number of accidents causing injury
- Increased absenteeism or lateness
- Reduced productivity
- Frequent stoppages
- Lower quality work
- Equipment damage

**Alcohol and performance**

Drinking alcohol can lead to increased sleepiness and reduced alertness, even after the alcohol is no longer detectable. This effect is commonly known as a hangover. Alcohol intoxication significantly impairs performance, as previously mentioned.

**Knowledge Check**

- Describe three ways sleep can be affected when you have more than four standard drinks before going to bed.
- Name four effects alcohol has on the body.
CHAPTER 9

Nicotine

Learning Outcomes

After reading through this chapter, you should be able to:

• Discuss the effects of nicotine on alertness.
• Discuss the effects of nicotine on sleep.
• Name symptoms of nicotine withdrawal.
CHAPTER 9

Nicotine

What is nicotine?

Nicotine is a stimulant found in the leaves of the tobacco plant. Tobacco has been smoked or chewed for centuries. Nicotine stimulates respiration and heart rate and depresses appetite by activating nicotine-sensitive nerve receptors. In small doses, it wakes you up and gives you a high by exciting the central nervous system. It is highly addictive and the dangers to health have been well documented.

Smoking cigarettes increases the chances of heart and lung disease and most smokers are less fit than non-smokers.

Cigarettes contain 1 to 20 mg of nicotine (depending on the brand and strength). The effect of nicotine mostly dissipates after 60 minutes. Nicotine readily diffuses through skin (patches), lungs (smoke), and mucous membranes such as the gums and the lining of the nose. The most common and quickest way for nicotine to enter the body is through the lungs. Nicotine moves to the small blood vessels, then to the brain, and finally to the rest of the body. Once it has reached the brain, it is responsible for the “good” feelings smokers experience. People usually keep smoking to maintain a constant level of nicotine in their bodies. The number of cigarettes it takes to do this varies from person to person because different people metabolize nicotine at different rates. People also have varying degrees of tolerance to and dependence on nicotine.

Nicotine withdrawal

Nicotine withdrawal can occur at night, making it difficult to fall asleep and stay asleep. Nicotine withdrawal may also contribute to nightmares and problems waking up in the morning. This is especially true for heavy smokers.

If you smoke, avoiding nicotine in the evening and at bedtime may help improve your sleep. If you stop smoking, you are likely to start sleeping better after 10 days without a cigarette. In heavy smokers, withdrawal symptoms can kick in 20-30 minutes after the last cigarette. Physical and mental withdrawal symptoms may include:

- headaches
- muscular aches
- sore gums and tongue
- impaired concentration
- low blood pressure

Fatigue Risk Management System for the Canadian Aviation Industry

46
• lowered heart rate
• feelings of stress or anxiety
• depression and irritability

Physiological symptoms of withdrawal peak three to four days after quitting but can last up to 10 days. Sleep improves dramatically after withdrawal symptoms have passed.

Knowledge Check

• Why might heavy smokers wake during the night?
• Name two negative health effects caused by smoking.
CHAPTER 10

Drugs

**Learning Outcomes**

After reading through this chapter, you should be able to:

- Name problems associated with sleeping pills.
- Explain the difference between prescription and over-the-counter drugs.
CHAPTER 10

Drugs

**Prescription drugs**

Some prescription drugs can affect your ability to drive or operate heavy machinery. They may also interact with existing fatigue levels and other drugs (including alcohol), further affecting your performance.

If you take prescription medication:

- ask your doctor about possible interactions with other drugs
- ask your doctor about the drug’s effects on performance, such as your ability to drive and operate machinery
- tell your supervisor what you are taking so they are aware of your situation (depending on the policies and regulations in your workplace)
- remember anaesthetics are prescription drugs that can show a positive result on a screening test – inform your supervisor if you’ve had an anaesthetic recently

Drugs that come with a warning not to drive or operate heavy machinery include:

- angiotensin (such as Losartan, Valsartan or Candesartan for blood pressure)
- antihistamines (Benadryl, Claritin, or Reactine for allergies)
- barbiturates (Amytal, Seconal, and Tuinal for sleep and anxiety)
- benzodiazepines (diazepam, alprazolam, and triazolam for sleep and anxiety)
- monoamine oxidase inhibitors (Nardil and Parnate for depression)
- phenothiazines (Mellaril and Thorazine for mental disorders)

Always check the warning labels on the packaging of your medication and ask your doctor or pharmacist if you are unsure.

**Over-the-counter drugs**

Some over-the-counter drugs used for pain relief or colds and flu may increase drowsiness and fatigue-related symptoms. If you are unsure about the drug you are taking, talk to your pharmacist or tell your supervisor so they are aware of your situation.
Some employees who work irregular schedules and have difficulty sleeping purchase over-the-counter sleeping pills. Examples of this type of medication include Nytol, Sominex, and Sleep-eze. Various antihistamines that cause drowsiness are sometimes used to help the onset of sleep. While these drugs can be effective for getting to sleep, they can also cause increased sleepiness the following day. Use of these drugs is better avoided where possible, and limited to no more than two nights in a row.

There are also over-the-counter drugs available to increase alertness. These include caffeine-based tablets or capsules (such as No-doz and Vivarin) and pseudoephedrine, which is a decongestant (such as Sudafed). While both can be effective in increasing alertness and decreasing fatigue-related symptoms, they also have side effects. Caffeine is a diuretic, which can dehydrate the body. If taken within four hours of going to bed, it can make it harder to fall sleep. Pseudoephedrine can cause increased anxiety levels, heart palpitations, and trouble sleeping. These symptoms have the potential to affect safety and work performance. It is recommended that use of stimulants be limited.

**How drugs work**

Drugs are taken into the body through the mouth (ingestion), blood (injection), or nose (inhalation). After they enter the bloodstream, they act on the brain. Drugs are eliminated from the body through the liver and kidneys into the urine. Drug effects vary not only from person to person; they can also vary for the same person depending on time of day, mood, tiredness, and the amount of food eaten. A person might get drunk on just a few beers one night but be hardly affected by the same amount on another night. Age, gender, and size of a person also influence the overall impact of drugs and the rate of recovery.

**Sleeping pills and sedatives (benzodiazepines)**

**Definition**

Benzodiazepines are a group of synthetic drugs prescribed by a medical practitioner mostly for the treatment of insomnia and anxiety. There are more than 30 different types available. They are taken orally or, more rarely, by injection. Some of the more common forms include:

- Valium
- Serapax
- Rohypnol
- Librium
- Mogadon
- Temazepam

**Drug effects**

Some benzodiazepines last as little as four to six hours, while others last as long as two to three days.

They are known to:

- relieve anxiety and reduce muscle tension, producing a feeling of calmness and relaxation
• cause sedation, drowsiness, blurred vision, and affected speech

In high doses, benzodiazepines produce symptoms similar to alcohol. In overdose situations they can cause unconsciousness, coma, and death. This is more likely to occur if benzodiazepines are combined with alcohol or other depressant drugs.

**Health effects**

Due to the tolerance and dependency effects of benzodiazepines, people are generally advised to take them for only short periods. Long-term usage can produce symptoms of:

- lethargy
- irritability
- lack of motivation
- nausea
- headaches
- disturbed sleep
- increased appetite
- depression
- loss of muscle and speech coordination

You can develop dependency on benzodiazepines after more than one week of use. This means that you:

- require higher doses to achieve the same effect
- will suffer physical withdrawal if you stop taking the drug – some people take up to a week before they begin to experience any withdrawal effect.

Once you stop taking benzodiazepines, withdrawal symptoms are common and may last up to a few weeks.

These symptoms include:

- headaches
- nervousness
- poor appetite
- disturbed sleep
- sweating
- anxiety
- vomiting
- muscle spasms
- depression
- flu-like symptoms

**Performance effects**

In general these drugs adversely effect:

- fine motor skills
- cognitive functioning
- alertness
- learning behaviour

They should not be taken when driving or operating machinery or in any other safety critical situation. They impair your ability to judge whether you are physically or mentally affected. Benzodiazepine use has been associated with hangover-type symptoms on waking. Users often report grogginess and drowsiness after using benzodiazepines. These effects could have implications for work safety. Chronic use can lead to impairment that persists long after you stop taking the drug. However, most users show improvements once they are no longer taking the drug.
**Interactive effects**

Combined with alcohol or other depressants in large doses, benzodiazepines exaggerate central nervous system depression, which can lead to respiratory suppression and death.

**Indicators of benzodiazepine use**

A person who takes benzodiazepines may show symptoms similar to those under the influence of alcohol. When used as a sleeping aid, benzodiazepines may produce hangover effects. That is, you may appear sluggish and show some mental confusion first thing in the morning. Some of the benzodiazepines, such as Rohypnol, cause memory loss during the time they are active.

**Clearance times**

In general, the time the body takes to clear the drugs varies between one and seven days depending on the drug and dosage. As you age, clearance times for long-acting benzodiazepines (like Valium) can greatly increase from a few days to a month. For people who abuse benzodiazepines, it may take up to six weeks for their systems to clear.

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**Knowledge Check**

- Name three problems associated with sleeping pills.
- How does age affect the body’s response to drugs?
- What is the difference between a prescription drug and a non-prescription drug?
CHAPTER 11

Well-being

Learning Outcomes

After reading through this chapter, you should be able to:

- List the body systems affected by non-traditional hours of work.
- Discuss the effects of non-traditional hours of work on reproductive health.
- Explain why shift workers have higher incidence of gastrointestinal problems than day workers.
Many studies have found health-related problems associated with non-traditional hours of work. In general, shift workers report a higher number of health complaints than day workers. Shift workers, especially those on rotating shifts, have a higher incidence of sick leave, a higher rate of visits to workplace clinics, and poorer scores on a variety of health scales.

Some of the most common complaints associated with non-traditional hours of work are sleeping problems, fatigue, and irritability. Physical systems affected include gastrointestinal, cardiovascular, and reproductive systems. Apart from specific disorders, the adverse effects of such hours on workers’ health also influence their general sense of well-being. Workers regularly report increased levels of stress, increased use of alcohol and other drugs, and a general feeling of weariness. This may be made worse by mental stress related to being less satisfied in the domestic and social areas of their lives.

**Gastrointestinal problems**

Research has shown that shift workers are four to five times more likely to develop a gastrointestinal disorder, such as peptic ulcers, indigestion, heartburn, flatulence, and constipation. As discussed in the chapter on food, the digestive system is less likely to tolerate some foods at night when it slows down.

In the short term, irregularities in food intake resulting from non-traditional or changing work patterns may lead to digestive problems and gastrointestinal complaints. While the more severe disorders generally develop over time, you can reduce your chances of being affected by them by changing your habits now.

Strategies to reduce long-term gastrointestinal problems include eating at normal meal times as much as possible. As discussed in the food chapter, you should think about your diet, what you eat and drink and when, and how it makes you feel.

It is important to be aware of early warning signs of gastrointestinal disorders, particularly peptic ulcers, which are one of the most serious. They can be treated fairly easily, however. If you think you may have a digestive disorder, consult your doctor.
Fatigue Management Strategies for Employees

Cardiovascular disease

Shift workers have a higher risk than day workers of developing cardiovascular diseases such as high blood pressure and heart attack. There is also a strong link between cardiovascular disease and genetics. If any of your biological family members have been diagnosed with cardiovascular disease in the past, you should pay more attention to your own lifestyle and factors such as exercise, diet, and smoking.

Practically speaking:

- It is important to know whether your family history includes cardiovascular disease.
- Regular check-ups of blood pressure and cholesterol can help detect problems early.
- Be aware that smoking is a major additional risk factor for cardiovascular disease.
- Always try to maintain a healthy balanced diet, low in animal (and other saturated) fat.
- Get regular exercise.

Pregnancy and reproductive health in women

There are specific female health problems associated with shift work. Studies have shown that women who work shifts, and night shifts in particular, complain more frequently of irregular menstrual cycles and more severe menstrual pain. Studies have determined a range of factors that women who work non-traditional hours should be aware of, including:

- an association between rotating shift work and how long it takes to become pregnant
- a relationship between an increased risk of spontaneous abortion and some forms of shift work
- a link between pre-term birth and night work
- an association between rotating shift schedules and lower fetal growth and birth weight

For some of these effects, the differences observed between shift workers and non-shift workers are statistically small. The body of evidence on reproductive health is also relatively small compared to other areas of research, such as effects of shift work on sleep. Nevertheless, it is wise to consider work hours as a potential factor in reproductive health.
General health complaints tend to be higher among shift workers than day workers. Have you experienced any of the following?

- Sleeping problems
- Irritability
- Fatigue
- Frequent colds and flu
- Headaches
- Gastrointestinal disorders (stomach and digestive upsets)
- Cardiovascular disease
- Pregnancy or reproductive health issues

Knowledge Check

- Name four types of health complaints often reported by shift workers.
- What is the most serious gastrointestinal disorder reported by shift workers?
- Name three factors that may contribute to cardiovascular disease.
CHAPTER 12

Physical Exercise

Learning Outcomes

After reading through this chapter, you should be able to:

• Name the effects of physical exercise on sleep.
• Discuss the effects of physical exercise on general health.
• Name the benefits of physical exercise.
CHAPTER 12

Physical Exercise

Establishing a routine

Many people who work non-traditional hours find it difficult to establish regular exercise routines. On average, female shift workers are 5 to 10 kg heavier than their non-shift working colleagues, while male shift workers are 10 to 12 kg heavier.

Regular, moderate exercise such as walking three to four times a week for 30 to 40 minutes can have benefits for health, regardless of age or working hours. Most people feel better for exercising. Exercise helps to relieve stress, boost your health, strengthen your immune function, and improve your muscle tone and strength. Before you begin an exercise program, talk it over with your doctor, especially if you are over 30 years of age.

Benefits of exercise

Being fit helps:

- reduce the risk of cardiovascular disease, which has a higher incidence in the shift working population
- make you feel good
- increase your stamina
- you get more enjoyment from your leisure time.

Exercise can also improve sleep. Research shows that exercise taken approximately 30 to 180 minutes prior to bed can increase the amount of deep (restorative) sleep that you obtain. One study found that late night exercise before bed even increased the feeling of a good sleep the next morning and reduced the amount of daytime sleepiness.

Potential benefits of exercise may include:

- improved sleep
- increased energy levels
- reduced muscle tension
- reduced stress
- improved muscle tone and strength
- increased aerobic fitness (heart and lungs)
- reduced body fat
- improved bone density
- increased stamina
- improved circulation with better digestion and body functioning.
Benefits associated with different types of exercise

<table>
<thead>
<tr>
<th></th>
<th>Walking</th>
<th>Running</th>
<th>Tennis</th>
<th>Dancing</th>
<th>Cycling</th>
<th>Golf</th>
<th>Swimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance</td>
<td>*****</td>
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<td>Strength</td>
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<td>**</td>
</tr>
</tbody>
</table>

*****Excellent **** Very good *** Good ** Poor * Very poor

(Source: Sydney Hospital, OH&S Unit, 1996)

What improvements could you make to your current level of physical fitness? Describe the first step you would take to achieve this.

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

What sort of benefits would you expect from increased fitness?

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

Knowledge Check

- Explain why you should engage in some form of physical exercise.
- Name three benefits of physical exercise.
- What should you do before you engage in any exercise program, particularly if you are over 30 years of age?
- What effect can physical exercise have on sleep?
CHAPTER 13

Social/Family Life

Learning Outcomes

After reading through this chapter, you should be able to:

• Explain the impacts that working non-traditional hours may have on family and social life.
• Identify strategies that may help to balance work and family/social life.
• Name the benefits of balancing work, family, and social time.
Unsocial hours

A healthy social and domestic life is an important foundation for good physical and mental well-being. Much of the research into shift work and non-traditional work hours shows that working “unsocial” hours creates unique family and social stresses. Generally, social time is arranged around the standard work week (9 a.m. to 5 p.m., Monday to Friday), and evenings and weekends are highly valued for social interaction and participation. Shift workers have been considered relatively “poor” in social time compared to those working traditional hours.

If the hours you work are constantly changing or unpredictable, the opportunities for social interaction are reduced. It may also be difficult for shift workers or those working non-traditional hours to see themselves as part of the community. Shift workers are less likely to be members of clubs, attend meetings, join political organizations, and undertake group activities such as sports.

Balancing family and work can be a source of conflict, regardless of whether you work traditional or non-traditional hours. Such conflict may make it hard for you to meet your family’s needs or expectations. Conflicts can worsen as the demands of work or family increase.

The conflicts associated with shift work or non-traditional working hours can hold especially true for women, as they generally assume responsibility for managing the house and parenting. However, many men are taking on equal responsibilities and experience similar pressures. In such situations, it is not uncommon for people to place family and social responsibilities before their personal needs. This often causes significant stress for the worker.

When people are not able to meet family and social obligations, they often feel a sense of isolation. This, in turn, can lead to depression, which can significantly affect the health and well-being of the worker.

As such feelings of isolation increase, people may begin to sacrifice sleep time for social or family time. This is a potential safety hazard for employees and employers. If you find yourself in this situation be aware of your elevated fatigue levels, and
Some working arrangements have potential advantages for families and activities outside of the workplace. One example is the 12-hour shift system. Assuming overtime is not worked, 12-hour shifts generally involve long uninterrupted blocks of time away from the workplace. These blocks of free time are often highly valued by employees because they provide the opportunity for a more flexible lifestyle. This may include being able to spend more quality time with family, time to relax and engage in social activities, or time to perform household chores. But it also has a considerable downside. On working days, employees have little time for anything other than work and sleep, which may contribute to difficulties with child care and involvement in daily family life.

Provide some examples of changes in family and social life that are brought on by non-traditional hours of work.
Coping strategies

There are a number of strategies that workers can use to balance work, social, and family time, and thus avoid feelings of isolation. One of the main strategies is talking about your work schedule with your partner and children. This can be effective in planning ahead to spend time together as a family. Your family will also be more aware of when you are likely to be sleeping after work. As a result, they can arrange to be out of the house when you are sleeping, or be more considerate of the need for quiet. This in turn can provide you with undisrupted sleep, allowing more energy for social and family interaction during non-work and non-sleep time.

Another strategy is to actively organize family and social events. Make a point of spending time with those close to you, including your family, friends, and colleagues. This may be organized on a routine basis around your work schedule to ensure regular contact.

Joining a recreational organization can also be a useful strategy to minimize feelings of isolation. This can be particularly effective for meeting friends who work a similar schedule to yours. It provides an opportunity to socialize and relax when most other people are working.

Knowledge Check

- Why are some working arrangements referred to as being “unsocial”?
- Describe two strategies that can help in balancing work and family.
CHAPTER 14

Commuting

Learning Outcomes

After reading through this chapter, you should be able to:

- Discuss why commuting can be a hazard for workers.
- Name strategies that may help reduce the risks associated with commuting.
Commuting as a hazard

So far, we have focused on fatigue as a workplace hazard. Driving to and from work when fatigued should also be considered a hazard. This is increasing in importance as commute times continue to grow significantly longer.

You will always be at risk of falling asleep behind the wheel if you are driving while tired or sleep deprived. There are certain high-risk times when you are more at risk of having a fatigue-related accident. These include:

- Long drives without a break
- Driving home after a long shift
- Driving between midnight and 6 a.m. (biological low point)
- Driving in heavy traffic
- Long stretches of road with low traffic

In many cities, it is not uncommon for people to commute an hour or even two hours to and from work. This situation arises mostly where jobs are scarce, property prices have driven people further out, or where traffic density is high.

What can be done?

While it is difficult to eliminate all the risks associated with commuting, it is possible to take some measures to improve road safety. While the following suggestions may not be relevant to everyone, you should be able to come up with a road safety strategy that suits you.

- Take public transport if it is available. This option is not only safer but is less expensive than running your own vehicle. For many people, the downside is losing the convenience of having your own car, and taking longer to get to and from work. Others argue that the extra travelling time can be well spent reading, relaxing, or just watching the world go by.
- Move closer to work. On first consideration, this may not be a realistic option but some who have done it report considerable benefits. This option is most attractive if you are renting or would be happy to sell your home to move closer to work. In some cases, such a move might be inexpensive and could save you five to ten hours a week of commuting.
• If you live close enough to work, consider riding, running, or walking to work. This is a particularly good strategy if you’ve been trying to get some regular exercise into your week. Another advantage is that, apart from the cost of shoes or a bike, it’s free!
• Car pool. This may be a viable option if you live close to people who work with you. Car pooling allows costs to be shared and gives the driver company during the ride, reducing the monotony of the drive.
• Don’t be in a hurry. Many accidents occur when people rush, so plan for delays and don’t get stressed out. Taking risks is unnecessary. Enjoy the conversation, music, or scenery during your journey.
• Never use a cell phone while driving. Recent research clearly shows that dividing your attention between driving and talking on a cell phone is dangerous. This is true even of cell phones with a hands-free attachment.

If a call is that important, find a safe place to pull over until the call is finished.
• Take a nap. As detailed in the sleep and napping chapter, naps can be a powerful and efficient strategy for gaining temporary improvements in alertness and performance. Naps are rarely convenient unless they are pre-planned, but you should get off the road if you observe any warning signs of fatigue. Keep your nap short, say 10 to 15 minutes, and be sure to give yourself at least 10 to 15 minutes to shake off your sleep inertia before you drive off. This wake-up time can generally be shortened if the nap is during the day.
• Have some caffeine. As covered in the caffeine chapter, caffeine can provide a boost to alertness, making commuting safer. Caffeine can reduce your ability to get to sleep once you get home, but it is more important to make it there safely.

Why is commuting a fatigue risk?

Are there any changes you could make to the way you commute that would reduce fatigue-related risks?
Marie was 38 years of age, married with one child at home. She was a pilot for almost 12 years, working in an emergency rescue operation. She had been called in to fly a hospital transfer for a critical patient. While the transfer was expected, the exact timing was unknown. Marie had experience with hospital transfers at all times of the day and night, so she was not worried about the timing.

She had been awake all day and had just gone to bed when the hospital rang at 11 p.m., asking her to pick up the patient. She arrived at the hospital after midnight and delivered the patient to the next hospital after 2:00 a.m. By the time she returned and completed her paperwork, it was past 5:00 a.m. Marie was tired but told her work colleagues that she wanted to drive home because she slept better in her own bed. She never made it.

There was no evidence of corrective action being taken by Marie before she hit the stationary semi-trailer. This suggests that Marie was either asleep or otherwise unable to react before impact. The investigation of the accident concluded that she had fallen asleep at the wheel on her way home.

Knowledge Check

- Propose three strategies Marie could have used to get home safely that morning.
- Name two reasons why many workers spend more time in their cars travelling to and from work?
CHAPTER 15

Work Schedule Design

Learning Outcomes

After reading through this chapter, you should be able to:

- Discuss respective responsibilities of employee and employer in the context of a fatigue risk management system.
- List considerations when designing working time arrangements.
- Explain the pros and cons of different types of shifts.
Chapter 15

Work Schedule Design

Shiftwork on the rise

It is estimated that fatigue is responsible for at least as many crashes on the road as alcohol. Despite this, fatigue has only recently begun to receive attention from regulatory bodies. As the workforce increasingly moves towards shift work and alternative working arrangements, the potential for fatigue-related risks increases. This problem is further compounded by the growing use of high-powered machinery where the margin for error is small and the potential for serious injury is high.

Globalization and competition are forcing organizations to adopt new flexible working time arrangements that include 24-hour operations.

There is little doubt that flexible working time arrangements have productivity benefits. Flexible, non-standard working hours are also attractive to employees whose home responsibilities and personal commitments prevent them from working traditional schedules.

Work schedule design as a countermeasure to fatigue

The best-known countermeasure to fatigue is sleep. Sleep opportunity is determined to a great extent by the hours you are not at work. Therefore, fatigue reduction strategies must include work schedule design. It is important to remember that there is no perfect working time arrangement that suits everyone all the time.

When designing working time arrangements, the following should be considered:

- length of shifts
- number of consecutive shifts
- direction of rotation in alternating shifts (forward or backward)
- type of shifts to be worked (nights, afternoons and mornings, days)
- staffing levels, experience, expertise, and opportunities for job rotation
- breaks between and within work periods
- types of tasks being undertaken, (repetitive, boring, exciting, stimulating)
- consulting with all stakeholders about developing new work schedules –
participation by all is likely to foster feelings of ownership of the outcome
• testing changes to the work schedule to determine impacts on the health, safety, and productivity of employees and the company.

**Employer and employee responsibilities**

Managing fatigue and associated risks are the dual responsibility of employers and employees. As will be seen in the next two sections, various types of shifts have various effects on workers and their lives, and entail some fatigue-related risks. Both employers and employees must be aware of the risks involved with various types of shifts. Examples of the respective responsibilities of employers and employees with regard to fatigue are listed below.

**Employer responsibilities**

- Appropriate and safe work schedule design that allows for adequate recovery periods during the shift and between shifts.
- Ensuring safe work practices, such as scheduling sensible levels of overtime.
- Appropriate and safe shift duration.
- Assessment, control, and monitoring of fatigue related hazards.
- Development of policies, procedures, and practices to manage risk related to fatigue. For example, where napping is allowed, there should be clear instructions on how to deal with sleep inertia.
- Providing information on workplace hazards, such as fatigue.

**Employee responsibilities**

- Arriving at work in a fit state to work the expected shift length.
- Reporting all incidents and accidents.
- Maintaining communication with work colleagues, management, and relevant unions.
- Being aware of fatigue and how to counter it in the workplace; for example, by getting adequate rest or sleep prior to work times.

**Different types of shifts**

There are a number of different types of non-traditional shifts that are worked in industry. Extended shifts are but one alternative to the regular 9-to-5 workday. Workers can also find themselves assigned to shifts starting early morning, in the afternoon, or at night. Work teams can be assigned to these shifts according to slow or fast rotations. There are no hard-and-fast rules about which shift schedule is best. However, as discussed below, some are more attractive than others in terms of the physiological, psychological, and social impact they have upon workers.

**Extended shifts**

Extended shifts involve either starting a shift earlier or finishing later than the standard 9-to-5 work day. There are many reasons an organization may choose to use extended shifts. In some cases, extended shifts allow for longer hours of production, without the need for night work. Extended shifts are also popular among employees because of the extra money they can earn working longer hours.
Alternatively, the standard 37.5 hour work week can be compressed into three or four days, allowing bigger blocks of time off between shift sequences.

Working the occasional extended shift is unlikely to significantly affect fatigue-related risk. This is especially so if the shift does not affect sleep opportunity (i.e., starting before sunrise, or finishing after “normal” bedtimes). Over longer periods, shifts longer than 10 or 12 hours should be avoided. Even if these shifts do not specifically affect your sleep periods, they will reduce the amount of social time available. Research has shown that employees often sacrifice sleep in exchange for a healthy social life if they do not have sufficient time for both, producing higher fatigue levels. If longer shifts are required, make sure you have adequate recovery time after your shift has ended.

**Night shifts**

Humans are diurnal, which means we are naturally active during the day and sleep at night. Because of this, it is particularly difficult to completely adjust to night shifts. Night work requires you to be awake when your natural tendency is to be asleep, which disrupts body rhythms and affects the quality and quantity of sleep. Night workers generally get less sleep, and the sleep they do get is of poorer quality than that of day workers.

Unlike most other animals, we are influenced and motivated by what we choose to do and how we choose to do it. Motivation plays a role in how you manage your work hours. Money has generally been used to compensate employees who work at non-traditional times. Those who work at night, in the evening, and on weekends are traditionally paid at a higher rate than those who work days, Monday to Friday.

**Morning shifts and afternoon shifts**

Although they may be less problematic than night shifts, morning and afternoon shifts are not without problems. Morning shifts that start before 7 a.m. force workers to cut sleep periods short, which can cause higher levels of fatigue at work. This has been supported by studies that show a higher frequency of accidents at the start of early morning shifts. As with the night shift, the risk of a fatigue-related incident if sleep is cut short over multiple days becomes a significant safety risk.

From a sleep perspective, afternoon shifts are ideal. Workers get home around 11 or 12 p.m., after which very few people would struggle to get 7 to 9 hours sleep. While for many people sleep is easiest after an afternoon shift it is not ideal from a social perspective. The evening meal with family or friends is valued by most as the most important period of social time. This is particularly the case for workers with young children at home. As discussed above, when individuals are deprived of social time by extended shifts, they will often sacrifice sleep to catch up on lost social time on other days. Again, this can cause a vicious cycle with fatigue-related risk.
**Shift rotation**

Where night work is required, rotating shifts are often employed to share the night shifts among employees, rather than restricting them to one group of employees. Employees working nights typically get less sleep, which can accumulate to cause high fatigue levels particularly over multiple days in a row. Using a rotating shift schedule can reduce fatigue-related risk by giving employees fewer night shifts in a row.

Research has found that rapid rotation of shifts (i.e., changing every few days) is preferable to a slow rotation. Similarly, rotating shifts forward (i.e., morning, afternoon, night) is preferable to rotating backward (i.e., night, afternoon, morning).

---

**EXERCISE**

Have you noticed any differences between your sleep patterns when you’re on night shift and when you’re on other shifts?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Do you have any suggestions about how current working hour arrangements could be improved? If yes, what are they?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

**Knowledge Check**

- Name three factors you should consider when designing work schedules.
- Name two employee responsibilities and two employer responsibilities with respect to managing fatigue-related risks.
- Name one negative aspect for each of the following shifts: morning, afternoon, and night.
Learning Outcomes

After reading through this chapter, you should be able to:

• Describe why long-distance travel causes jet lag.
• Explain why travelling east can produce more jet lag than travelling west.
• Provide practical strategies to ease the effects of jet lag.
Jet lag is a condition caused when we travel across time zones, and our normal circadian rhythms are disrupted. It is experienced in the form of physical and psychological discomfort. The symptoms may include excessive sleepiness, feeling depressed, reduced efficiency, and premature awakening. Some people also experience this for the first day or two following the change to daylight saving time, when bed and wakeup time is shifted by an hour. Since daylight saving time only displaces our body clocks by an hour, the effects are likely to be minimal. Likewise, crossing only one or two time zones is not likely to produce substantial effects of jet lag.

The determining factor in the impact and experience of jet lag is how many time zones are crossed. Since time zones change only when travelling in east or west directions, north-south flights produce far less jet lag. For example, flying from Vancouver to Montreal (three hours difference) will produce substantial jet lag. However, a traveller on a north-south flight of the same duration – Vancouver to Los Angeles, for example – will not be affected by jet lag, only fatigue resulting from travelling.

Jet lag and the body clock

The body clock has already been discussed in Chapter 1 in terms of the effects of shift work and trying to sleep during the day. While circadian irregularities are fundamentally the same for international travel, there are two main differences between shift work and jet lag:

- the time zone change associated with jet lag is preceded by the fatiguing activity of travel
- the day/night environment surrounding sleep will have changed (i.e., become earlier or later), which confuses the body clock
- although the new “night” sleep actually occurs during the local nighttime when it is dark, it may still be daytime at home and thus not a normal sleep time

Effects of jet lag

It is easier to move our sleep and waking time forward rather than backward, making the day longer rather than shorter. Eastbound travel shortens the day or
night, so travelling west produces less jet lag.

You are more likely to be effected by jet lag by flying east because:

• depending on the distance travelled, you lose several hours of sleep time
• your body clock will only partially reset when changing time zones. The body clock takes an average of one day to adjust for each time zone crossed. A difference of four hours between home and local time may take you up to four days to adjust.

The impact and experience of jet lag varies dramatically between individuals. How you are affected depends on many factors, including:

• direction of travel (travelling west is easier)
• physical fitness (better fitness improves circadian adjustment)
• age (the effects of jet lag increase with age)

One of the most common symptoms of jet lag is sleep disruption. This is likely to include:

• difficulty getting to sleep at regular bedtime
• waking up during the night and not being able to get back to sleep
• fighting sleep during the day

This level of sleep disruption is likely to lead to insufficient sleep quality and quantity, and subsequent fatigue.

In 1994, a survey was conducted of international flight attendants in New Zealand. Almost all flight attendants surveyed said that despite being accustomed to international travel, they regularly suffered from jet lag. One of the particular symptoms reported by the flight attendants following a long flight was a sensation of confusion or “fuzziness.” For example, some flight crew members reported checking to make sure their hotel rooms were locked two or three times.

**Easing the effects of jet lag**

The most obvious technique for minimizing the effects of jet lag is maximizing sleep quality and quantity. Methods vary between individuals. Three useful tips are recommended:

• set up your sleeping environment to minimize light and noise disturbance, and set the temperature to between 18 and 24°C
• drink lots of water
• keep physically fit

Resetting the body clock is more easily accomplished gradually than all at once. Depending on the direction you have travelled, and how long you plan on staying at the destination, one option is to start adjusting sleep and eating times before you leave. Even shifting your bed and meal times by an hour or two can jumpstart the change in your body clock in the right direction.

Ensure you are well rested before the flight. Many travellers are tempted to stay
up late, and get very little sleep before a flight so they will be able to sleep better upon arrival at their location. In reality, people who are already in sleep debt before a flight will experience more symptoms than those who are well rested. Other than sleep, one of the easiest and most practical techniques to ease the effects of jet lag is to drink plenty of water. Dehydration and the dry air aboard aircraft can cause headaches and nasal irritation, which exacerbate the symptoms associated with jet lag. Drink lots of water before, during, and after the flight. Some tips to remember are:

- take a large bottle of water with you on the flight – water is better than coffee, tea, soft drinks, and fruit juices
- avoid coffee and alcohol, which are diuretics and cause dehydration
- avoid overeating (especially salty foods)
- avoid motion sickness drugs when possible (they are depressants).

Regular exercise also has a large impact on the severity of jet lag. People who are unfit tend to experience longer periods of jet lag.

Regardless of your actual fitness, being forced to remain immobile is one of the most taxing aspects of long flights. Move around and exercise wherever possible, throughout the flight or during stopovers. Don’t worry what other people think. If you look like you’re enjoying yourself, they may get up and join in.
Have you ever experienced jet lag? Describe your experience.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What techniques do you use to cope with jet lag?

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________________________________________________________________________

________________________________________________________________________

Based on what you have just read about jet lag, are there any changes you should think about making? If so, what?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Knowledge Check

- Explain what causes jet lag.
- Identify two factors that can affect the experience of jet lag.
- Explain two ways to ease the negative effects of jet lag.
Suggested Readings

- Canadian Health Network website: www.canadian-health-network.ca
- National Sleep Foundation website: www.sleepfoundation.org
Fatigue Risk Management System for the Canadian Aviation Industry

Employee Training Assessment

April 2007
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Notices

This report reflects the views of the authors and not necessarily the official views or policies of Transport Canada.

Transport Canada does not endorse products or manufacturers. Trade or manufacturers’ names appear in this report only because they are essential to its objectives.

Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Cahier d’évaluation de l’employé», TP 14574F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adelaide, Australia.

The FRMS toolbox consists of six components:

1. **FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue**, TP 14572E: introductory material intended to raise awareness about fatigue

2. **FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees**, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. **FRMS for the Canadian Aviation Industry: Employee Training Assessment**, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. **FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System**, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. **FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines**, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. **FRMS for the Canadian Aviation Industry: Trainer’s Handbook**, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
Contents

Introduction .................................................................1
Fundamental Knowledge Questions .................................3
Employee Logbook Instructions ........................................9
Acceptable Responses to Fundamental Knowledge Questions ..........11
Logbook Checklist ..........................................................17
Competency Assessment Results ........................................19
The purpose of this assessment is to evaluate individual competence in each of the topics covered in *Fatigue Management Strategies for Employees*. Each chapter in the workbook begins with a set of learning outcomes that detail the knowledge and skills to be learned by the end of each chapter. Students should have completed each of the exercises and knowledge checks in the workbook before beginning this assessment.

The assessment process uses two approaches to evaluate employee competency in fatigue management. First, employees are asked direct questions intended to assess knowledge obtained from the workbook. Employees are asked to maintain a logbook to demonstrate competence in applying the concepts of fatigue risk management to their specific work, social, and family situations.

This booklet consists of five elements:
- Fundamental Knowledge Questions
- Employee Logbook Instructions
- Acceptable Responses to Fundamental Knowledge Questions
- Logbook Checklist
- Competency Assessment Results

The first two elements form the assessment tasks, and should be completed by employees. The Acceptable Responses and the Logbook Checklist are intended primarily for a designated assessor to determine whether employees have provided appropriate answers and information. However, it may be useful to provide this material to employees during the assessment. This will ensure employees know the types of answers/information they are expected to provide for each question. If the answers to the fundamental knowledge questions are provided to employees, the assessor should conduct a verbal assessment, asking questions at random. The assessor should primarily ask highlighted questions (see page 3).

The form provided in Competency Assessment Results serves as a certificate of competence. The feedback provided on this form should state whether the individual has demonstrated competence in fatigue risk management, and highlight any areas that need further attention.
The assessor may be a safety manager within the organization, who has achieved competence in fatigue risk management principles. Alternatively, assessors can be commissioned from external sources (such as universities or private consultants) to provide a more objective examination of employee responses.

**How to use this assessment unit**

First, ensure the workbook exercises have been completed. These questions can be used to determine how well the topic information has been understood.

Employees should complete the first two parts of the assessment:
- Fundamental knowledge questions
- Employee logbook

The fundamental knowledge questions can be answered in the space provided in this booklet. The logbook should be completed in a separate notebook on a day-to-day basis for one month. Employee Logbook Instructions outline a number of elements that should be demonstrated and/or considered within the actual work environment. Employees should cover each in their logbooks. If the organization already practises good fatigue risk management principles, and the employee already understands and uses these principles, the logbook can be completed retrospectively. That is, employees can detail how they approached the required elements listed on pages 9-10 in their specific work environment in the past.

**Assessment criteria**

The knowledge questions and the logbook form the majority of the assessment criteria. To complete the course, employees should have a one-on-one interview with a designated assessor. The assessor asks random questions from the fundamental knowledge questions to test the employee's understanding. The assessor also asks questions based on the logbook, calling for the employee to describe how various components of fatigue risk management were applied to the specific work situation. Following the interview, the assessor completes the Competency Assessment from on page 19 and provides feedback to the employee based on the assessment.
List three examples of work-related factors that affect fatigue.

There are three categories of fatigue symptoms that may be observed at work or away from work: physical, mental, and emotional. List two examples of fatigue symptoms for each category of symptoms.

**PHYSICAL SYMPTOMS**

**MENTAL SYMPTOMS**

**EMOTIONAL SYMPTOMS**

What is the major shortcoming of simply relying on observations of symptoms to manage fatigue?
List four advantages of implementing fatigue management strategies in the workplace.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

After waking from a nap, why is it critical to wait 15 to 20 minutes before you undertake any safety-critical tasks, including driving?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

To recover from fatigue, a one-hour nap has the same restorative value as an eight-hour sleep.

☐ True    ☐ False

A 30-minute nap followed by at least 15 to 20 minutes to wake up significantly improves a person’s alertness for the drive home.

☐ True    ☐ False

What is the shortest napping period that delivers measurable improvements to your alertness?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Food digestion becomes slower at night because the body is not programmed to process food at this time. Name three ways this can adversely affect you.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
Drinks that contain caffeine, such as coffee, tea, cola, and energy drinks may help to increase your alertness levels. However, if you consume drinks like these frequently throughout the day, caffeine will not be as effective at improving your alertness. Explain why.

Name two strategies that help reduce fatigue levels.

At what time of day are fatigue levels generally at their highest?

Name one shift work related health issue that is experienced only by women.

List two factors that may disrupt your sleep without waking you up.

How does a pre-bed routine help you get to sleep?

When is the most effective time of day for recovery sleep?
Name three types of foods you should eat to reduce fatigue and maximize alertness.

What is the least amount of water you should drink each day to avoid dehydration?

If you do not drink enough water, you may become dehydrated. How does dehydration affect alertness levels?

List two signs you need to drink more water.

Describe three ways your sleep is affected by consuming more than four standard alcoholic drinks before bed.

List two dangers of taking sleeping pills over extended periods of time.

List three ways you can let your family and friends know your work schedule and when you are free.
Having a healthy social and family life is important for physical and mental well-being. Explain two things you can do to help balance your working hours and your family and social life.

________________________________________________________________________

Describe two strategies you can use to avoid falling asleep while driving.

________________________________________________________________________

Fatigue can cause performance impairment similar to alcohol in drivers.

□ True       □ False

List five strategies that can help daytime sleep.

________________________________________________________________________

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________________________________________________________________________

What are three common health problems experienced by shift workers?

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________________________________________________________________________

List five potential advantages of physical exercise.

________________________________________________________________________

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________________________________________________________________________

________________________________________________________________________
List two strategies that can ease the effects of jet lag.
Employee Logbook Instructions

After completing the Fatigue Management Strategies for Employees, employees should keep a logbook or diary for one month detailing how they have applied the strategies outlined in the workbook to their specific work situation.

If an organization is already active in managing fatigue, and employees regularly apply good fatigue risk management practices, they do not need to complete a day-by-day, one-month diary. Instead, their logbook may describe specific instances when they have applied the strategies outlined below.

The logbook should:

1. Detail specific instances of action employees have taken in the workplace to reduce potential causes of fatigue in themselves (at least two examples), such as:
   - developing interest in the job/task or motivation for the job/task
   - opportunities to control the type or work or task, or when and where
   - physical activity (walking and stretching)

2. Detail specific instances of action taken in the workplace to reduce potential causes of fatigue in colleagues (at least one example). This may include some of the examples provided above, or direct confrontation and intervention with a colleague.

3. Demonstrate that employees know where to find and have consulted relevant documentation available within the organization (e.g., FRMS policy and procedures, safety management system policy, labour standards, provincial or federal legislation).

4. Demonstrate that employees apply fatigue management strategies in accordance with company policy:
   - roster/schedule/route concerns are raised and communicated with appropriate colleagues or supervisors
   - conversation with work colleagues to improve alertness
   - eating stimulating foods or drinks, low GI or high-protein foods; strategic use of caffeine
   - improving environment (e.g., increasing light)
• company policies may include occupational health and safety rules, procedures manual, etc.

(Workplace examples of schedules/routes/job tasking could be provided to employees to help them suggest two improvements that might reduce fatigue. This may be done as an activity in groups of two or three during the face-to-face training workshop.)

5. Detail specific examples of how the employee’s lifestyle has been modified to promote effective long-term management of fatigue in the workplace (at least three examples). Examples include:
• managing sleep disorders
• using caffeine strategically
• reducing travelling time
• modifying sleep environment
• car pooling
• communicating needs and concerns with others
• improving diet and exercise
• reducing drug intake

6. Discuss personal sleeping habits and identify potential weaknesses or issues that can be worked on (at least two examples). For example:
• blocking out light
• reducing noise
• moderating ambient room temperature
• taking warm shower before bed
• relaxing before bedtime
• avoiding caffeine/alcohol before bedtime
List three examples of work-related factors that affect fatigue.

High number of hours of work; high number of consecutive shifts; not being provided with or not taking breaks; working significant hours during the night or early morning; monotonous, boring tasks; long shifts; high physical or mental job demands.

There are three categories of fatigue symptoms that may be observed at work or away from work: physical, mental, and emotional. List two examples of fatigue symptoms for each category of symptoms.

Physical Symptoms: involuntarily nodding off; waves of sleepiness; poor hand-eye coordination; yawning; sore eyes; etc.

Mental Symptoms: trouble focussing on tasks; making errors; having lapses in attention; being unable to recall the last five minutes; problems communicating effectively; etc.

Emotional Symptoms: lack of energy; irritability; moodiness; etc.
What is the major shortcoming of simply relying on observations of symptoms to manage fatigue?

Although effective at low to moderate levels of fatigue, high levels of fatigue cause judgment to be impaired which can result in no action or the wrong action being taken.

List four advantages of implementing fatigue management strategies in the workplace.

Higher alertness; improved safety; improved communication; more effective work capability

After waking from a nap, why is it critical to wait 15 to 20 minutes before you undertake any safety-critical tasks, including driving?

To ensure sleep inertia has passed; to allow time to become fully awake and alert

To recover from fatigue, a one-hour nap has the same restorative value as an eight-hour sleep.

False

A 30-minute nap followed by at least 15 to 20 minutes to wake up significantly improves a person’s alertness for the drive home.

True

What is the shortest napping period that delivers measurable improvements to your alertness?

Ten minutes
Food digestion becomes slower at night because the body is not programmed to process food at this time. Name three ways this can adversely affect you.

Indigestion; feeling bloated; build-up of stomach acid; disruption of sleep; constipation; weight gain or loss; peptic ulcers

Drinks that contain caffeine, such as coffee, tea, cola, and energy drinks may help to increase your alertness levels. However, if you consume drinks like these frequently throughout the day, caffeine will not be as effective at improving your alertness. Explain why.

Tolerance to caffeine develops with frequent use, meaning that the same amount of caffeine is no longer as effective.

Name two strategies that help reduce fatigue levels.

Optimize sleep periods; use the sleep opportunities provided in the roster; promote a good sleeping environment (plus additional strategies outlined in the workbook, e.g., strategic use of food and drinks, naps, etc.).

At what time of day are fatigue levels generally at their highest?

Midnight to 6 a.m. (and especially 3 a.m. to 5 a.m.)

Name one shift work related health issue that is experienced only by women.

May take longer to get pregnant; increased risk of miscarriage; pre-term birth; slower fetal growth rate; irregular menstrual cycle

List two factors that may disrupt your sleep without waking you up.

Outside noise; bright light; hot bedroom temperature; alcohol
How does a pre-bed routine help you get to sleep?

It programs your body and mind to prepare for sleep. It helps your body wind down towards sleep as you make your way to bed. This should reduce the time it takes for you to fall asleep.

When is the most effective time of day for recovery sleep?

At night (between midnight and 6 a.m.)

Name three types of foods you should eat to reduce fatigue and maximize alertness.

Low fat, high protein; fruits and vegetables; whole-grain breads and cereals

What is the least amount of water you should drink each day to avoid dehydration?

Two litres

If you do not drink enough water, you may become dehydrated. How does dehydration affect alertness levels?

It makes you feel lethargic and sluggish. This can increase the feeling of fatigue.

List two signs you need to drink more water.

Feeling thirsty or dehydrated; light-headed; headache; your urine is bright yellow or orange as opposed to pale yellow.

Describe three ways your sleep is affected by consuming more than four standard alcoholic drinks before bed.

Alcohol significantly reduces the quality of sleep; sleep is lighter, fragmented, and you need to get up to go to the toilet more often.
List two dangers of taking sleeping pills over extended periods of time.

The body develops a tolerance and will need more of the drug to get the same effect; addiction; impaired performance the following day.

List three ways you can let your family and friends know your work schedule and when you are free.

Talk to them about your schedule; write it in a household diary/calendar; stick your schedule on the fridge; plan activities with them as far ahead as possible; tell them what you are doing day to day.

Having a healthy social and family life is important for physical and mental well-being. Explain two things you can do to help balance your working hours and your family and social life.

Talk to friends and family about your work hours and the effect this has on you to help them gain a better understanding and to enable them to be supportive; let your family and friends know when you are sleeping, busy, or free; give a copy of your schedule to your family and friends; arrange events yourself so that you do not feel socially isolated.

Describe two strategies you can use to avoid falling asleep while driving.

Don’t drive if you’re tired: stop when you’re tired; use caffeine strategically; make sure you’re adequately rested before driving; use napping strategically, including allowing adequate time to recover from sleep inertia.

Fatigue can cause performance impairment similar to alcohol in drivers.

True
List five strategies that can help daytime sleep.

Sleeping in a dark, cool, and quiet room; talking with your family or household about your sleep requirements; establishing a good sleep environment; wearing earplugs; turning off the phone; putting a sign on your door to let people know you are sleeping; using foil or heavy curtains to block out the sunlight; establishing a pre-bed routine; avoiding caffeine two to four hours before bedtime; minimizing alcohol consumption prior to sleep; using white noise to dampen external noises; using an answering machine; telling your neighbours when you are sleeping so they don’t mow the lawn or perform other noisy tasks; getting your partner to take preschool children out for a few hours so you can sleep in a quiet house; having a bath to relax before bed; learning relaxation techniques; learning to meditate; not panicking if you can’t sleep; do something else and then try again.

What are three common health problems experienced by shift workers?

Sleeping problems; fatigue; stomach and digestive complaints; stress; irritability; weight gain or loss; cardiovascular disease

List five potential advantages of physical exercise.

Improved sleep; decreased fatigue; increased energy levels; reduced muscle tension; reduced stress; improved muscular tone and strength; reduction in body fat; improved bone density; increased stamina; improved circulation with better digestion and body functioning; greater flexibility

List two strategies that can ease the effects of jet lag.

Be well rested before the flight; drink lots of water; set up a healthy sleeping environment; maintain physical fitness; shift meal times to match new time zone.
Logbook Checklist

Supervisors or assessors should use this checklist to confirm that information detailed in the employee logbooks (or retrospective reports) covers all required components.

Name of employee: ____________________________________________

The employee logbook:

• provides two different examples of appropriate action taken in the workplace to minimize potential causes of fatigue ☐ Yes ☐ No

• provides one example of appropriate action taken in the workplace to minimize potential causes of personal fatigue in colleagues ☐ Yes ☐ No

• demonstrates the employee uses strategies to manage fatigue in accordance with company policy ☐ Yes ☐ No

• demonstrates the employee knows where to find and how to use relevant documentation available in the workplace ☐ Yes ☐ No

• provides two to three examples of how the employee has made lifestyle changes to better manage fatigue in the workplace ☐ Yes ☐ No

• identifies two to three potential weaknesses in sleeping habits ☐ Yes ☐ No

• Employee’s logbook entries authenticated ☐ Yes ☐ No
Competency Assessment Results

**Employee assessment**

Name of employee: ____________________________

Employee’s performance on the fundamental knowledge questions was:

☐ Satisfactory ☐ Not satisfactory

Employee's logbook was:

☐ Satisfactory ☐ Not satisfactory

The employee needs to improve in the following areas before re-assessment:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Feedback to employee:

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________

Employee Training Assessment 19
Signatures:

The employee has been informed of the assessment decision and provided with appropriate feedback.

Name of assessor: ____________________________________________

Signature of assessor: _________________________________________

Date: ________________________________________________________

I have been informed of the assessment decision and provided with appropriate feedback.

Signature of employee: _______________________________________

Date: ________________________________________________________
Fatigue Risk Management System for the Canadian Aviation Industry

Developing and Implementing a Fatigue Risk Management System

April 2007
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Notices

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Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Élaboration et mise en œuvre d’un système de gestion des risques liés à la fatigue», TP 14575F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adelaide, Australia.

The FRMS toolbox consists of six components:

1. FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue, TP 14572E: introductory material intended to raise awareness about fatigue

2. FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. FRMS for the Canadian Aviation Industry: Employee Training Assessment, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. FRMS for the Canadian Aviation Industry: Trainer’s Handbook, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
Contents

Introduction ........................................................................................................................................1
  The Aim of This Guide ......................................................................................................................1
  Your Role ........................................................................................................................................1
  How to Use This Guide ...................................................................................................................1

1. Overview of Fatigue Risk Management .......................................................................................3
  Causes and Consequences of Fatigue ............................................................................................4
  Managing Fatigue Levels ................................................................................................................5
  A Risk-Based Approach ..................................................................................................................8
  An FRMS Working Group ..............................................................................................................11

2. Responsibility for Managing Fatigue under an FRMS .................................................................13

3. Policies and Procedures ............................................................................................................17
  FRMS Policy ..................................................................................................................................18
  Developing FRMS Policies ............................................................................................................18

4. Training and Education .............................................................................................................21
  Determining Training Needs ..........................................................................................................22
  Fatigue Management Education and Training ..............................................................................23
  The Training Environment ............................................................................................................24
  Fatigue Management Training and Education Outcomes ..............................................................24

5. Level 1 Controls: Providing Sufficient Sleep Opportunity .......................................................27
  Assessing Schedules for Adequate Sleep Opportunity ................................................................29
  Fatigue Modelling ..........................................................................................................................31
  Designing the Ideal Shift System ....................................................................................................32
  Considerations to Maximize Sleep Opportunity in Designing Work Schedules .......................32

6. Level 2 Controls: Assessing Actual Sleep ..................................................................................35
  Assessing Adequacy of Level 1 Controls ......................................................................................39
7. **Level 3 Controls: Assessing Symptoms of Fatigue** .................................................. 41
   - Identifying At-Risk Individuals ................................................................. 43
   - Insomnia .................................................................................................. 46
   - Sleep Apnea ......................................................................................... 46
   - Restless Leg Syndrome and Periodic Limb Movement ......................... 46
   - Narcolepsy ............................................................................................ 47
   - Sleep Clinics ......................................................................................... 47
   - Assessing the effectiveness of other levels of control ............................ 47

8. **Level 4 and 5 Controls: Fatigue Proofing and Reporting Incidents and Accidents**
   - Level 4: Fatigue-Proofing Strategies ................................................... 50
   - Level 5: Incident Investigation – Asking the Right Questions ............... 52

9. **Internal FRMS Audit** ................................................................. 55

**Resources** ............................................................................................. 61
Introduction

The Aim of This Guide

This guide is designed for individuals who are responsible for managing fatigue risk at an operational level. You should already have completed the Fatigue Management Strategies for Employees (TP 14573E) workbook or equivalent, which provided information about the causes and consequences of fatigue, and included practical strategies for managing the impact of fatigue. Fatigue Management Strategies for Employees focussed on reducing fatigue risk at the individual level. You should now be familiar with the risks associated with fatigue and the major contributors to increased fatigue levels (i.e., inadequate quality and/or quantity of sleep, time of day, and length of time awake). This guide explains how the risks associated with fatigue can be managed at the organizational level within a safety management system framework. You will learn how to implement fatigue risk management controls systematically within your organization.

Your Role

As an individual in a managerial or supervisory role you are accountable not only for managing your own fatigue levels but also the fatigue risk of employees within your organization and/or work unit. The tools and strategies presented in this guide have been developed to help you manage fatigue risk at various levels, ranging from ensuring compliance with legal and regulatory requirements to investigating and learning from accidents and incidents in the workplace. Managing fatigue-related risk in the organization is achieved using a fatigue risk management system (FRMS).

How to Use This Guide

This guide describes how an FRMS is best employed within an organization's safety management system. This allows the risks associated with fatigue to be managed in a way similar to other hazards such as dangerous goods. An FRMS should be based on an internal risk assessment of the organization. This ensures that any fatigue management strategies being implemented are measured, appropriate,
and targeted. There are several Canadian national standards for risk assessment, all of which clearly outline acceptable guidelines for risk management (e.g., CAN/CSA-Q850-97, CAN/CSA-Q634-91).

The fatigue risk management system described in this guide provides your company and employees with a recognized process based on likelihood and consequence and the need to identify, understand, and control the workplace hazard. The resources and time required for implementing a fatigue risk management system will be determined by the relative risk identified during your risk assessment process.

There are six major aspects to an FRMS:

1. Policies and Procedures
   - Outline the commitment of organizational management to manage fatigue-related risk
   - Detail the required procedures for managing fatigue at the operational level

2. Responsibilities
   - List personnel responsible for FRMS design, implementation, and maintenance
   - Document responsibilities of individual employees and work groups

3. Risk Assessment/Management
   - Scheduled versus actual hours of work
   - Individual sleep patterns
   - Symptom checklists
   - Error/incident reporting

4. Training
   - Promote knowledge in the workplace about risks, causes, and consequences of fatigue
   - Ensure employees understand and can apply fatigue management strategies

5. Controls and Action Plans
   - Toolbox of methods used within the FRMS, including error reduction techniques (“fatigue proofing”)
   - Clear decision trees for managers and employees to use when fatigue has been identified as a risk

6. Audit and Review
   - Documentation and data collection at regular intervals of how the FRMS works
   - Review of the FRMS based on audit results

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Learning Outcomes

On completing this chapter, you will be able to:

- Explain reasons underlying the need for organizations to implement fatigue risk management systems.
- Explain the limitations of prescriptive hours of work for managing fatigue-related risk.
- Name the major components of a fatigue risk management system (FRMS).
Overview of Fatigue Risk Management

In recent years, organizations have become better at managing workplace risks including issues such as materials handling, use of seatbelts and safety harnesses, as well as exposure to harmful chemicals. As these risks have been reduced, other threats have become more apparent. This is particularly true of fatigue, which until recently was not well understood or easy to measure. Recent research and applied management strategies are beginning to provide solutions for individual employees and organizations to better manage fatigue-related risk. This chapter of the guide provides information about managing fatigue-related risk within a safety management system (SMS) framework. This incorporates a formal risk assessment and will likely fit within existing organizational safety management structures. The rationale for the development of a fatigue risk management system is also provided in this chapter.

Causes and Consequences of Fatigue

Fatigue is an experience of physical and/or mental tiredness that results in reduced alertness and negatively impacts performance. The major cause of fatigue is not having obtained adequate rest or recovery from previous activities. In simple terms, fatigue largely results from inadequate quantity or quality of sleep. As discussed in Fatigue Management Strategies for Employees, there are many consequences of fatigue and they fall into three major categories – physical (e.g., abruptly nodding off for a few seconds, called a microsleep), mental (e.g., lapses in attention) and emotional (e.g., irritability).

The fatigue associated with tiredness and reduced alertness is different from physical fatigue or weariness that is caused by long and/or hard physical work. In this case, fatigue may be more accurately defined as mental fatigue although it certainly affects physical performance as well – especially tasks that require mental-physical interactions like hand-eye coordination, reaction time, and fine motor skills. Other skills that are impaired by fatigue include attention, vigilance, concentration, ability to communicate information clearly and accurately, and decision-making. Impairment can lead to fatigue-related errors, which in turn can lead to incidents or accidents. Evidence
from industrial and government investigations as well as industrial risk data demonstrates that fatigue and sleepiness are major contributors to incidents and accidents across the entire transportation industry. Incidents and accidents that result from fatigue can be severe and may include fatalities but are most often associated with employee injury and/or equipment damage.

**Managing Fatigue Levels**

An understanding of both the causes and consequences of fatigue enables us to design more effective systems to manage fatigue-related risk. Fatigue is sometimes managed indirectly by organizations (and regulators) through prescriptive limits on work hours, often because it is seen as the only available option. There is an assumption that prescribing maximum limits for the length of work shifts and minimum thresholds for breaks between shifts ensures that employees achieve adequate rest and recovery. This assumption most likely evolved from information about the way in which humans recover from physical fatigue. Physical fatigue accumulates and diminishes in a predictable way over time, as shown in the figure below.

![Graph showing the accumulation and dissipation of physical fatigue](image-url)

**The manner in which physical fatigue accumulates and dissipates in relation to work and rest**
Based on this assumption, the management of physical fatigue by limiting work hours and managing break periods is logical and practical. However, the same may not be assumed for mental fatigue. Common approaches for managing this type of fatigue often assume that the factors that cause mental fatigue are similar to those that cause physical fatigue. And while it is true that mental fatigue does, in part, increase in a relatively predictable way over time during waking hours and dissipate over a period of recovery, time is not the only factor that needs to be considered. The most important factors affecting mental fatigue levels are:

- **Sleep quantity and quality** – insufficient or poor quality sleep results in increased fatigue levels. This is because both how much and how well one sleeps are important for recovery from fatigue and for maintaining normal alertness and performance. This applies not only to a single sleep period, but to consecutive sleep periods. If an individual gets inadequate sleep (quality or quantity) over a series of nights, this also causes increased fatigue.

- **Time awake** – how long an individual is awake affects fatigue levels. Research indicates that alertness and performance levels begin to decrease after a certain number of hours awake.

- **Circadian rhythms** – fatigue levels are also affected by the time of day. For example, fatigue can be a bigger problem in the early hours of the morning due to biological (or circadian) rhythms. Sleepiness levels are naturally higher and alertness levels are lower at 3 a.m. than at 3 p.m. Circadian rhythms also influence sleep quality and quantity. For instance, sleep obtained during the day is poorer in quality compared to night sleep, when the body is programmed to sleep.

It is not correct to assume that a given break from work will provide a given level of recovery; the length of the break is not the key factor. It is the amount and quality of sleep obtained in the period of time away from work that determines recovery from fatigue. The timing of a work period within the 24-hour day will also determine fatigue risk.

Both work and non-work factors can affect sleep. Work-related factors – length of shifts, the type of work being performed, workload, work environment (e.g., heat, humidity, noise, vibration, lighting levels) and breaks within a shift – can all influence the amount of sleep and time awake obtained in a 24-hour period.

Non work-related factors – sleep disorders, family responsibilities, social and leisure engagements, and emotional stress – can all affect the amount and quality of sleep people obtain. These factors can also affect the length of time individuals are awake, which can also affect fatigue. The figure below shows the relationship between each of these factors.
The relationship between sleep, time awake, circadian rhythms, and fatigue, as well as the effect of work and non-work factors on sleep and time awake.

With all of the contributing factors in mind, it is easy to understand why prescriptive limits on work hours may not, on their own, be adequate for managing fatigue-related risk. Prescriptive limitations on shift length generally assume that a break of a given length has a predictable recovery value; for example, that a 10-hour break will allow the same recovery to take place regardless of when the break occurs. While this may be relatively true for physical fatigue, it is definitely not the case for mental fatigue. Providing the same time off during the day, as opposed to night, may result in less recovery due to the effect on sleep. Factors such as this must be taken into account when developing an FRMS.

The FRMS should be embedded within the existing SMS framework to allow fatigue to be managed within existing organizational safety structures. This also ensures that responsibility for managing fatigue risk is shared between employer and employee. It may also allow safety professionals or other stakeholders in the company to develop a cost-effective FRMS without needing to call in outside fatigue expertise. However, it is important to have an understanding and appreciation of fatigue-related risk within a workplace. The figure below illustrates how fatigue can be incorporated into an overarching SMS.

Fatigue risk management systems work best within the framework of a larger safety management system.
A Risk-Based Approach

Managing fatigue-related risk under an SMS framework involves developing comprehensive defences against the hazard of fatigue based on a formal assessment of risk. Organizations can decide to do as much or as little as necessary to manage their own levels of risk.

An important theorist in the area of organizational risk management, James Reason, describes the "normal" environment in organizations that generally precedes a workplace incident. Reason suggests that there is no 100% effective safety control for any hazard (such as fatigue). The inherent weaknesses or "holes" in a given safety defence provide opportunities for incident "trajectories" – the series of events and conditions leading to an incident – to penetrate the defence.

An effective safety management system or, in this case, fatigue risk management system, should use multiple, overlapping, and redundant defences against a given hazard. In a multi-layered system, an incident can only occur when all the defensive systems fail. That is, in circumstances where the incident trajectory passes through the holes in each of the defensive layers. The effectiveness of the safety management system can therefore be improved by (1) the appropriate selection of supplementary layers, and/or (2) strengthening individual layers (shrinking the holes).

Reason’s principles for the development of an SMS can be easily applied to a fatigue risk management system. The figure below shows a hazard control diagram for fatigue. Vulnerabilities along the fatigue-related incident trajectory should be identified so that supplementary defensive layers can be introduced and/or existing defensive layers can be strengthened. Investigating incidents also ensures that appropriate hazard controls are put in place at each level of potential risk.
In general, fatigue has traditionally been managed using a single layer of defence (i.e., limits on work hours). The assumption is that compliance with the limits on working hours is evidence that an employee is adequately rested and fit for work and will not make any fatigue-related errors. This may not always be the case. Without supplementary defensive layers it is entirely possible for an employee to comply with working hour limits but to be too tired to work safely (e.g., had a 12-hour break from work but didn’t get enough sleep due to a sick child or a night out on the town). Each of the five levels of control is discussed in separate chapters, but a brief description of the theory is provided below.

<table>
<thead>
<tr>
<th>Hazard Assessment</th>
<th>Error Trajectory</th>
<th>Control Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep opportunity</td>
<td>1</td>
<td>Prescriptive CARs requirements, Fatigue modelling</td>
</tr>
<tr>
<td>Sleep obtained</td>
<td>2</td>
<td>Prior sleep/wake data</td>
</tr>
<tr>
<td>Fatigue-related symptoms</td>
<td>3</td>
<td>Symptom checklists, Self-reporting, behavioural scales, Physiological monitoring</td>
</tr>
<tr>
<td>Fatigue-related errors</td>
<td>4</td>
<td>Fatigue-proofing strategies, SMS error analysis system</td>
</tr>
<tr>
<td>Fatigue-related incidents</td>
<td>5</td>
<td>SMS incident analysis system</td>
</tr>
</tbody>
</table>

Hazard-Control Model for Fatigue Risk Management

The hazard control model illustrated in the figure above shows the controls in place for reducing fatigue-related risk. In theory, if each level of control is in place, the “holes” in the management system along the incident trajectory should become smaller, minimizing the likelihood of a fatigue-related incident.
Briefly, a fatigue-related incident is preceded by a fatigue-related error. In turn, a fatigue-related error is generally preceded by fatigue-related behaviours. Fatigue-related behaviours or symptoms in turn indicate that an employee has either not had adequate sleep (not enough or not enough good sleep), or has been awake for an excessive period of time. Finally, inadequate sleep or excessive time awake may occur as a result of inadequate sleep opportunity (i.e., too short a break between work shifts).

There are five major levels of control for managing fatigue risk:

- Level 1 (organizational): making sure scheduling gives employees adequate opportunity to sleep
- Level 2 (individual): making sure employees actually get sufficient sleep
- Level 3 (behavioural): monitoring for symptoms that indicate employees are fatigued
- Level 4 (error): strategies to ensure that fatigue in the workplace does not result in errors or incidents
- Level 5 incident: determining the role of fatigue in workplace errors or incidents

A successful fatigue risk management system addresses each of these levels by organizing defence systems around these layers. Most fatigue countermeasures (either formal or informal) can be assigned to one of the five defensive layers.

The FRMS should be developed and implemented using a risk-based approach. Organizations should determine the specific level of fatigue-related risk associated with their operations. Organizational risk should be assessed in terms of the type of work being conducted as well as the environment in which the work takes place. After identifying high-risk areas for fatigue within the workplace (by work group or by specific tasks), systems can be put in place to either reduce or eliminate fatigue through processes such as schedule reform (fatigue reduction) or through the implementation of mitigating strategies such as napping and task rotation (fatigue proofing).
This increases the range of opinions and ensures that information is received from all levels of the organization. Working group members should also have the opportunity to consult with other operational personnel, bringing an even wider range of perspectives to the process of FRMS design, implementation, and review. This is best achieved through two-way communication of program objectives, milestones, progress, and the involvement of all employees in the development and review processes.

**Working Group Training**

Members of the working group may require some training about the causes and consequences of fatigue and how to manage the risks. Training for the working group should:

- outline fatigue, its associated risks, and management strategies at the individual level
- provide strategic information on the daily management of fatigue from an organizational perspective
- detail effective FRMS design and implementation processes
- provide information about how to evaluate and audit the FRMS over time.

This type of training can be obtained from *Fatigue Management Strategies for Employees* (TP 14573E) and this guide. Further reading on these issues can be found in the list of resources included at the end of this guide.
CHAPTER 2

Responsibility for Managing Fatigue under an FRMS

Learning Outcomes

On completing this chapter, you will be able to:

• Define specific responsibilities for both employers and employees for fatigue risk management.
One of the key features of risk-based approaches to safety management is that all stakeholders share responsibility for minimizing risk and increasing safety. This approach works particularly well for managing fatigue. Management has a responsibility to create a work environment that minimizes fatigue-related risk, and employees have an obligation to ensure that time away from work is used appropriately. Spreading responsibility for fatigue risk management across the entire organization represents a significant shift in thinking.

In the past, responsibility for safety has generally been mandated by the regulator, who prescribed the level of safety management required and audited the organization to determine compliance. If safety was found to be poorly managed and resulted in an accident or incident, the organization could be held legally liable and face fines or a jail sentence. Thus, if an employee fell asleep at work and caused an accident, the organization could potentially be held responsible.

As our understanding of the hazards of fatigue has increased, we have begun to recognize the many different contributors to the risk. It is now accepted that the regulator, the organization, and employees each have certain responsibilities for fatigue risk management. The main responsibilities are summarized in the table below.

In the context of an FRMS, both employers and employees have responsibilities for the management of fatigue. The employees’ responsibility is first, to obtain sufficient sleep; second, to report when they have been unable to do so or feel at risk of making a fatigue-related error; and finally, to report any situation observed that may present fatigue-related risk. The employer has the responsibility of providing adequate sleep opportunity, mitigating fatigue-related risk, and taking action if an employee is not fit for work. Managers and supervisors are responsible for taking prompt, consistent, and appropriate action whenever they believe an employee is not fit for duty. The action(s) to be taken should be set out clearly and consistently in all documentation, including policies and procedures. The aim of all actions should be to maintain and promote safety.
### Responsibilities for Fatigue Risk Management

<table>
<thead>
<tr>
<th>Government/Regulatory Responsibilities</th>
<th>Organizational Responsibilities</th>
<th>Individual Responsibilities</th>
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<tbody>
<tr>
<td>• Prescribe requirements/framework for FRMS</td>
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<tr>
<td>• Assess compliance</td>
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<td>• Audit non-compliance</td>
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<tr>
<td>• Where appropriate, investigate accidents/incidents</td>
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<tr>
<td>• Provide support:</td>
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<tr>
<td>- Compliance with legislation</td>
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<tr>
<td>- Policy development</td>
<td></td>
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<tr>
<td>- Training and education</td>
<td></td>
<td></td>
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<tr>
<td>- Error/incident reporting systems</td>
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<td></td>
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<tr>
<td>• Ensure work schedules provide adequate opportunity for rest and recovery between shifts</td>
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<td></td>
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<tr>
<td>• Assess specific work tasks for fatigue-related risk</td>
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<tr>
<td>• Use time away from work appropriately to obtain adequate rest and recovery, and ensure fitness for work</td>
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<tr>
<td>• Report any potential risks to manager if experiencing fatigue-related symptoms</td>
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<td></td>
</tr>
<tr>
<td>• Report any situation that may present fatigue-related risk</td>
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Actions to be considered when an employee is considered potentially unfit for work may include:

1. Assessing the employee using a symptom checklist as a guide to physical, mental, and emotional signs of fatigue (see Chapter 7).
2. Providing closer regular supervision of the employee by peers, work team, or supervisor.
3. Giving the employee lower-risk tasks.
4. Providing the employee with an opportunity to rest/nap and to be reassessed within a determined time frame.
5. Discussing with the employee what the employee thinks were factors in being unable to maintain fitness for work.
6. Determining whether prescription medication, alcohol, or drugs may be involved or have contributed to the situation.
7. Determining whether a similar set of circumstances is likely to recur, and if so, how could it be satisfactorily addressed by either the employee and/or manager for a mutually acceptable outcome.
8. Providing alternative transport home, if warranted.
9. Assisting the employee to access support and assistance where available (e.g., employee assistance programs).
Employee assistance programs (EAPs) are confidential services funded by companies and provided to any employee who may require assistance for personal, work, and/or family-related concerns or problems. In some organizations, the service is extended to immediate family members (i.e., current spouse and children). Referrals can be made by an employee, supervisor, manager, or medical officer. Service providers can be internal or external to the organization with services varying in scope, range, and intensity.

**EXERCISE**

- Detail who is responsible for each FRMS component within your organization.
CHAPTER 3

Policies and Procedures

Learning Outcomes

On completing this chapter, you will be able to:

- Describe the importance of developing an FRMS policies and procedures manual.
- Write a mission statement, outlining the scope, objectives and purpose of the FRMS and design subsections of an operationally specific policies and procedures manual.
As discussed in Chapter 1, it is the responsibility of company management, or a fatigue risk management working group, to produce a policies and procedures manual. This includes ensuring that employees are consulted and have the opportunity to provide feedback throughout the policy development process. The goals, objectives, implementation, and day-to-day operation of the FRMS should be clearly documented and communicated to all stakeholders.

FRMS Policy

The policies and procedures manual defines fatigue and its associated risks and creates a common understanding within the organization about the principles and standards for dealing with fatigue-related risks. The FRMS policy helps align all organizational efforts toward the ultimate goal of improved safety. If employees are consulted throughout the development of the policy and are supportive of the process, it is more likely they will take a positive, proactive approach to fatigue risk management at the individual as well as organizational levels.

FRMS policies and procedures should:

- meet existing legal/regulatory/industrial requirements for fatigue risk management
- suit specific operational needs
- allow intra-organizational flexibility (i.e., the rules for one work group may not necessarily be the same as another within the same company)
- not place unnecessary economic burdens on organizations

Developing FRMS Policies

Studies have found that many organizations need guidance in designing FRMS policies that are both specifically suited to their operational needs and that meet regulatory approval. Transport Canada has published a companion document to this guide that offers guidelines for the development of policies and procedures (see Policies and Procedures Development Guidelines, TP 14576E).
FRMS policies are often developed over a period of several months. Many organizations begin by releasing an over-arching mission statement to set the framework and to underscore the backing of senior management of the organization (e.g., CEO, general manager, board members). The mission statement should also be incorporated as a single paragraph into the organization’s existing SMS policy (for more information on developing the policy and mission statement, see Section 3.2 of Policies and Procedures Development Guidelines). In addition to stating management support, the mission statement should outline the scope, purpose, and objectives of the FRMS. The document need not be any longer than a page. An example is provided below.

**ABC Company**

**Fatigue Risk Management Mission Statement**

ABC Company is committed to protecting all employees, clients, and visitors from fatigue-related risk.

ABC’s fatigue risk management system aims to continually improve the safety of its flight operations by managing fatigue-related risk and by ensuring that staff consider at all times the safety implications of their own fatigue, and that of their colleagues.

*ABC Company’s fatigue risk management policy is backed by the strongest commitment at the highest level.*  
*(signed by managing director)*

**Sample FRMS Mission Statement**
After announcing the support of senior management through the mission statement, the detailed design of the FRMS policies and procedures manual can begin. The responsibility for developing, implementing, and maintaining the FRMS manual should ultimately rest with the individual responsible for safety or with a more formal fatigue working group (also known as the FRMS committee). However, there should be opportunities for employees to provide input. It is important that employees understand the purpose as well as the required elements of the FRMS policy. The consultation should be undertaken by the person or committee responsible for the development, implementation, and operation of the FRMS policy.

Studies have underscored the benefits of ensuring that employees are involved in all new and ongoing policy initiatives. This not only ensures buy-in from employees, but also improves the likelihood that the goals and action plans set out in the policies are based on the true capability of the organization and its employees.

The detailed FRMS policies and procedures manual should describe the various levels of fatigue hazard controls to be put in place at the company and the related procedures for each. Usually the manual covers:

- responsibilities of employees under the FRMS
- communication and consultation processes
- hours of service and scheduling
- verification of actual sleep
- monitoring of fatigue-related symptoms
- fatigue-proofing strategies
- reporting protocols
- training and education
- review and improvement process

### Exercise

- Describe the importance of developing an FRMS policies and procedures manual.
- Write the scope, purpose, objectives and definitions for your organization’s FRMS.
Learning Outcomes

On completing this chapter, you will be able to:

- Determine the fatigue training needs of your organization.
- List the resources required to support a fatigue management training program.
CHAPTER 4

Training and Education

**Determining Training Needs**

There are three main factors to consider when designing and implementing an FRMS training program:

1. Level of existing knowledge within the organization
2. The level of fatigue-related risk within the organization
3. Requirement of resources for training within the organization

Training is an essential component of a fatigue risk management system. Before designing and implementing a training program, an organization should determine the level and method of training required. For example, if fatigue risk management is relatively new to an organization, it may need to start with a basic training program about fatigue and how to manage it at a personal level (i.e., *An Introduction to Managing Fatigue* (TP 14572E)). An organization that understands the risk of fatigue may choose to go directly to more detailed instruction about applied management strategies (i.e., *Fatigue Management Strategies for Employees*, TP 14573).

A risk assessment of the various work tasks and the work environment also helps in developing a training program. Companies with low fatigue-related risk may decide to launch a basic workplace awareness program. Companies where fatigue-related risk is high or extreme may require employees to follow competency-based training with regular refresher courses.

Another factor to take into account is the size of the organization. A small company with only 20 employees in a single location may choose to hire an external trainer to present the training package to all employees at the same time. A company with several locations may choose to use a web-based package that employees can complete in their own time and at their own location. If an organization already has an in-house safety training program, it can train its own trainers to deliver a fatigue management training program. The *Fatigue Risk Management for the Canadian Aviation Industry: Trainer’s Handbook* (TP 14578E) may be useful for companies that choose this option.
Factors to consider when designing a fatigue risk management training program

<table>
<thead>
<tr>
<th>Level of Fatigue Risk</th>
<th>Resources</th>
<th>Employee Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Working hours</td>
<td>• Financial commitment</td>
<td>• Geographic location</td>
</tr>
<tr>
<td>• Work tasks</td>
<td>• Time for development</td>
<td>• Literacy skills</td>
</tr>
<tr>
<td>• Work environment</td>
<td>• Time for implementation</td>
<td>• Venue</td>
</tr>
<tr>
<td>• Frequency of fatigue-related accidents</td>
<td>• Workplace culture – most effective methods of training</td>
<td>• Rates and reasons for sickness/absenteeism</td>
</tr>
<tr>
<td>• Likelihood and consequences of fatigue-related error</td>
<td>• Availability of in-house trainers</td>
<td>• Current knowledge</td>
</tr>
<tr>
<td>• Regulatory requirement</td>
<td>• Training materials</td>
<td>• Existing competencies</td>
</tr>
</tbody>
</table>

The table above provides a summary of various things to take into consideration in implementing a training program.

When the training needs and levels have been identified, it will be necessary to:

- determine the content of the training package
- determine the time frame and schedule for completion of training
- allocate the necessary resources to ensure the successful roll-out and follow-up of the course

**Fatigue Management Education and Training**

Fatigue training is most efficient when it provides both knowledge and know-how.

The aims of any fatigue training should be clearly stated in the course outline. The time devoted to the course should reflect the priority and importance of fatigue issues for the organization. Typically, face-to-face training can run from 60 minutes to eight hours.

In the past, organizations typically provided short educational sessions about fatigue. While such sessions are important for raising awareness, there is often a low rate of knowledge retention with this type of training. Employees may take some information away but since details are quickly forgotten, they are unlikely to alter any of their habits at work or away.

More recently, organizations have begun using competency-based training techniques, which require employees to apply what they have learned to their individual situations. This approach promotes better knowledge retention among trainees. In addition, formal competency-based assessments can assure an organization that employees understand the concepts presented and can apply them to
their work situation. Refresher training should be given annually for the first two years, and every two years after that. Refresher courses also provide an opportunity to disseminate new information from the evolving field of fatigue management and allow employees to consolidate prior learning.

**The Training Environment**

Investment in training can be wasted if it is not framed by a real learning environment. Employees who attend training courses may not actually know why they are there or how they will be followed up. Some managers may show little interest in helping or encouraging employees to implement changes based on their training. It is important to develop a training environment as well as a training course. An environment that promotes learning provides:

- appropriate notice for course attendance (i.e., several weeks compared to several hours)
- any prior reading required (i.e., refresher course materials, background information, etc.)
- course location and aims
- facilities for training (i.e., training room rather than lunch room, air-conditioned environment, quiet, etc.)
- training support materials and facilities (e.g., printed materials, audio-visual presentations, white board, paper, pens, etc.)
- appropriate record keeping of course attendance and future courses required

**Fatigue Management Training and Education Outcomes**

On completion of training, it is expected that:

- Employees know and understand the organization’s fatigue management policies and procedures.
- Managers and employees know and understand their responsibilities in managing fatigue.
- Personnel know how to identify and manage risks associated with fatigue at both a personal and organizational level.
- Those responsible for decisions influencing sleep opportunities for employees know and understand their responsibilities and implement appropriate fatigue-reduction strategies where necessary.
- Training records have been made and stored in an appropriate place.
• Determine the need for fatigue training within your organization.
• Develop a training program for the organization.
• Develop a training report that you would present to senior management; within this report, identify (1) resources required, (2) training times, and (3) trainer to conduct the fatigue training course for employees.
CHAPTER 5

Level 1 Controls: Providing Sufficient Sleep Opportunity

Learning Outcomes

On completing this chapter, you will be able to:

- Describe the characteristics of a schedule that would increase the likelihood of work-related fatigue.
- Assess the scheduling practices of your organization with respect to mental fatigue.
In the past, fatigue has been largely managed through scheduling regimes, usually through rules governing hours of work imposed by regulators, organizations, or union bodies. In a fatigue-risk management system, however, there are five major levels of control: organizational, individual, behavioural, error, and incident level. A successful fatigue risk management system addresses each of these levels by organizing defence systems around these layers. This chapter addresses Level 1 of the hazard control model.
Level 1 controls are aimed at ensuring that the work schedule provides employees with sufficient sleep opportunity. To achieve this, the following factors should be considered:

- length and timing of shifts
- length and timing of breaks
- number of shifts worked in a row
- number of days off between shifts

Using factors such as these, an organization can predict, on average, how much sleep an employee will obtain. This chapter provides an overview of some strategies for assessing work schedules and their impact on sleep, alertness, and fatigue.

**Assessing Schedules for Adequate Sleep Opportunity**

The major reason for assessing work schedules, apart from ensuring that they comply with industry requirements and other rules, is to understand the likely impact that specific hours of work have on sleep opportunity. Sleep is the only cure for fatigue. In the context of an FRMS, the employer has the responsibility to ensure that adequate opportunity is provided for sleep between work shifts. It is the employee’s responsibility to use the opportunities given to obtain recovery sleep.

Most people need between seven and nine hours sleep to maintain safe performance and alertness levels. Depending on the time of day that a break is provided, the amount of time off needed to get adequate sleep could be as little as 10 hours and as much as 20 or more. This reflects the fact that employees do not simply fall asleep as soon as they leave work and wake just before they return. People have many activities and responsibilities to manage between shifts such as commuting to and from work, eating, showering, socializing, relaxing, spending time with family and friends, etc. To ensure adequate rest, sleep opportunity needs to include time for employees for recovery sleep and other activities.

Work schedules may be assessed by examining specific aspects of the hours of work. The questions provided below can be used as a guide, but they should not be seen as a complete list for all circumstances. Sleep opportunity alone should not determine appropriate schedules, even though it is generally the most important factor. For example, early morning start times generally produce higher levels of fatigue, but a 5 a.m. start may be more appropriate than working under extremely hot and humid conditions in the afternoon. This reflects the risk-based approach of safety management systems (as discussed in Chapter 3).

The following are some questions that could be asked to assess sleep opportunity and potential fatigue:

a. How many hours are worked per seven-day period? Not surprisingly, as total hours worked increase, sleep opportunity decreases.

b. What is the maximum shift length? As the length of a given shift increases, the subsequent sleep opportunity decreases.
c. What is the minimum length of time off between shifts? A short break is defined as a single sleep opportunity between subsequent work periods. It is typically a period of less than 32 hours. Not surprisingly, as the break between subsequent shifts decreases so does the sleep opportunity.

d. How many hours are worked between 9 p.m. and 9 a.m.? This question considers late finishes, early starts and night work. All of these will reduce night sleep opportunity and result in a significant reduction in total sleep opportunity.

e. How often do employees get a long break from work? A long break is defined as a period of two night sleeps with a non-working day in between. Long breaks typically provide a significant opportunity to recover from sleep loss accumulated over a series of shifts.

The table below provides an example of how questions like those above can be quantified into a rule system.

<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Total hours per 7 days</td>
<td>&lt; 36 hours</td>
<td>36.1 – 43.9</td>
<td>44 – 47.9</td>
<td>48 – 54.9</td>
<td>55+</td>
</tr>
<tr>
<td>b) Maximum shift duration</td>
<td>&lt; 8 hours</td>
<td>8.1 – 9.9</td>
<td>10 – 11.9</td>
<td>12 – 13.9</td>
<td>14+</td>
</tr>
<tr>
<td>c) Minimum short break duration</td>
<td>&gt; 16 hours</td>
<td>15.9 – 13</td>
<td>12.9 – 10</td>
<td>9.9 – 8</td>
<td>&lt; 8</td>
</tr>
<tr>
<td>d) Maximum night work per 7 days</td>
<td>0 hours</td>
<td>0.1 – 8</td>
<td>8.1 – 16</td>
<td>16.1 – 24</td>
<td>&gt; 24</td>
</tr>
<tr>
<td>e) Long break frequency</td>
<td>&gt; 1 in 7 days</td>
<td>&lt; 1 in 7 days</td>
<td>&lt; 1 in 14 days</td>
<td>&lt;1 in 21 days</td>
<td>&lt; 1 in 28 days</td>
</tr>
</tbody>
</table>
In the table above, a 9 a.m. to 5 p.m. work week (5 days in a row) would produce a score of zero. On the other hand, a work schedule of seven 12-hour night shifts, followed by seven days off would produce a score of 21, which would be considered high. The figure below shows examples of schedules scored using this approach.

![Fatigue Likelihood Score](image)

**Fatigue Likelihood Score**

**Examples of different schedules scored using the Fatigue Likelihood Scoring Matrix**

Calculating a score for a schedule allows companies to quantify what they deem to be acceptable or unacceptable. The cutoff score for an acceptable schedule will be determined by the specific characteristics of the organization. For example, an organization could choose to assign a lower cutoff score for highly complex or safety-critical work, or for a high-stress work environment (e.g., high humidity) than for less critical work in an air conditioned environment.

In the beginning, cutoff scores will be best estimates. However, as an organization’s understanding of its own fatigue hazard improves through collecting data on actual sleep (see Chapter 7) and fatigue-related errors, it should reassess scores that show signs of providing insufficient sleep opportunity.

**Fatigue Modelling**

Although fatigue cannot be measured like alcohol or drug impairment, there are ways it can be assessed. Work schedules can be used to predict fatigue based on the likely sleep loss caused by a specific shift pattern. Predictive software models can provide fatigue likelihood scores on the basis of a schedule.

Many models predict fatigue based on planned or actual hours of work. In doing
so, they consider a number of factors known to be relevant for work-related fatigue. These factors include the timing and duration of all previous work shifts (with more weight given to the most recent shifts). Most models also allow comparison of the fatigue scores that various schedules may impose on an employee population. In addition, organizations can set different threshold values for fatigue likelihood scores, based on a risk assessment of tasks within their operation. In other words, a score may be designated acceptable for low-risk tasks, but unacceptable for tasks that involve a much higher potential safety risk. One limitation of such a system, however, is that it does not tailor predictions for every single employee.

As with any fatigue management tool, testing devices and models should form part of an integrated system, not replace it. Each organization should understand the likely impact of fatigue in the context of the work tasks that its employees perform.

Considerations to Maximize Sleep Opportunity in Designing Work Schedules

As discussed in Chapter 1, prescriptive rules based solely on schedule design may be appropriate for ensuring recovery

A fatigue-friendly schedule would ensure that all shifts are finished between nine and ten o’clock at night so employees could go home and easily get eight hours of sleep without having to wake up too early. However, such a schedule leaves little time for socializing or spending time with family, and could lead to feelings of social isolation and depression.

A social-friendly schedule, on the other hand, would have employees starting work in the early hours of the morning and finishing mid-afternoon to enable them to spend time with family and friends. However, since it is unlikely that an employee would go to bed before ten or eleven o’clock at night, this type of schedule significantly limits the opportunity for sleep before the next shift.

The ideal shift for one employee is not likely to satisfy all employees. For example, a schedule that suits an employee with two young children would be unlikely to suit another employee who likes to sleep in and stay up late. While sleep should be the primary concern, other factors (such as family and social life) should also be considered when designing new shift systems.
from physical exhaustion. However, they are of limited benefit in managing mental fatigue. More effective strategies for reducing physical and mental fatigue focus instead on the time available for sleep (or sleep opportunity) and actual sleep obtained (see next chapter).

Things to consider in designing work schedules include, but are not restricted to:

• limiting night shifts
• reducing shift length to 12 hours or less
• limiting early morning starts
• limiting extended duty hours/over-time
• recording and controlling overtime
• ensuring appropriate breaks during shifts (coffee, meals, etc.)
• providing sufficient time off between shifts to allow for minimum sleep requirements
• limiting long blocks of work (i.e., multiple days worked one after the other)
• planning as much of the actual hours of work as possible
• creating a napping policy and facilities, including a process for managing sleep inertia

EXERCISE

• List some of the main characteristics of a work schedule that increases the likelihood of obtaining sufficient sleep between shifts.
• What score would your typical work schedule produce on the Fatigue Likelihood Scoring Matrix?
• Explain why you might choose a computer-based modelling tool over prescriptive hours-of-work rules.
CHAPTER 6

Level 2 Controls: Assessing Actual Sleep

Learning Outcomes

On completing this chapter, you will be able to:

- Identify employees who are at risk for fatigue-related impairment.
- Identify some of the reasons why employees may not obtain sufficient sleep.
- Describe potential processes for dealing with employees who have had insufficient sleep.
Level 1 controls presented in the previous chapter are intended to provide adequate sleep opportunities to employees. However, the organization has little control over what employees actually do or, specifically, how much sleep they actually obtain after they leave the workplace.

Level 2 controls are aimed at ensuring that employees get adequate sleep whenever they are provided sufficient sleep opportunity. This level of control is aimed at the individual level rather than at the organizational level.
Developing and Implementing a Fatigue Risk Management System

Level 2 controls play two main roles within the fatigue risk management framework:

- They identify employees who, even given sufficient sleep opportunity, fail to obtain sufficient sleep.
- They can be used to assess the effectiveness of Level 1 controls.

While Level 1 controls provide an indication of the quantity of sleep likely to be obtained, it is important to know whether there is still a risk of fatigue at the individual level.

There are a number of reasons why employees may not get sufficient or sufficient quality sleep. Some may not be within the employee’s control. For example, parents with a newborn baby are likely to get reduced amounts of sleep. An employee with a partner who is a chronic snorer may be awakened periodically throughout the night. An employee with a business on the side may suffer from reduced sleep opportunity. Insomnia or life stress may keep an employee awake at night. An employee working night shift may simply be unable to sleep during the day. Or, an employee may be irresponsible and put social time and partying ahead of obtaining sufficient sleep to ensure fitness for duty. Regardless of the circumstances causing insufficient sleep, fatigued employees should be identified and treated as a potential workplace hazard.

Before discussing different kinds of action to take when employees do not get enough sleep, it is important to quantify “sufficient” sleep. How much sleep each person needs every 24 hours to perform optimally varies – in general it is between seven and nine hours. Research has found that a person can maintain alertness and performance for a single day on approximately six hours sleep. However, more sleep is needed on average over two or more nights, or performance – and safety – are likely to decline significantly. Even a few nights of five or six hours of sleep is likely to result in poorer performance, communication, and functioning in most individuals.

Another factor that should be considered in addition to total sleep time is the time since an employee last had a sleep or nap (i.e., length of time awake). Considerable scientific evidence suggests that the longer an individual has been awake the poorer their capacity. This is especially true if the total time since the last sleep or nap extends beyond 16 or 18 hours.

There are various ways to assess the sleep employees obtain. With the agreement of employees – and any other stakeholders, such as unions – companies may decide to set up a system where employees calculate for themselves how much sleep they have had and how long it has been since their last sleep period or nap. Employees may be required to report when their sleep or time awake doesn’t meet the requirements. For example, in a high-risk operation it might be agreed that any employee who has had less than 6 hours of sleep in 24 hours, or 12 hours of sleep in 48 hours, or has been awake for longer than 18 hours, must report to the supervisor. A simple method of calculating whether an employee is likely to be fatigued based on sleep and time awake is illustrated below.
On reporting:

- **Six hours sleep in the previous 24 hours, and 12 hours sleep in the previous 48 hours:** the employee might be instructed to go to work as normal.
- **Five hours sleep in the previous 24 hours, and 11 hours sleep in the previous 48 hours:** the employee might be instructed to continue work, but to closely monitor fatigue-related behaviours or symptoms.
- **Five hours sleep in the previous 24 hours, 11 hours sleep in the previous 48 hours, and 18 hours awake:** the employee might be instructed to take a nap and have a strong cup of coffee on waking up to minimize the risk of fatigue.
- **Four hours sleep in the previous 24 hours and ten hours sleep in the previous 48 hours:** the employee might be instructed to have a strong cup of coffee, and work under close supervision of colleagues and managers.

This calculation tool can be printed on a wallet-sized card for easy reference by employees and managers.

A company may also decide that employees can, within reasonable limits, assess their own requirements for sleep and report to their supervisor when they do not meet minimum limits. This simple and practical process can flag sleepiness and fatigue issues before they lead to an incident.

When employees report to a supervisor that they have had insufficient sleep, it is important that clear procedures be in place to manage the risk in a consistent manner. This helps managers perform their duties and ensure that decision-making is based on clearly understood rules. The countermeasures to adopt should take into account the level of risk inherent in the tasks involved. The example below illustrates six possible scenarios of insufficient sleep that would require different actions by management.
• **Four hours sleep in the previous 24 hours, and eight hours sleep in the previous 48 hours:** the employee might be assigned to less critical tasks to minimize the consequence of potential errors.

• **Two hours sleep in the previous 24 hours and five hours sleep in the previous 48 hours:** employees might be told to stop work, and either go home to sleep (if they live close by) or take a nap on the premises because they are unfit to drive.

Sleep thresholds are likely to vary from organization to organization, task to task, and individual to individual. If the threshold is set too low, it will be picked up by the subsequent levels of the hazard control system. For example, if employees are getting the recommended minimum amount of sleep (e.g., six hours per night), but still exhibit fatigue behaviours and symptoms (see Chapter 7), and if they are not suffering from a sleep disorder, it is likely that the minimum level of sleep is insufficient. Each organization – or even work group – should establish its own sleep thresholds and decision trees for when employees have not met the sleep requirements.

**Assessing Adequacy of Level 1 Controls**

Level 2 controls allow an organization to verify whether Level 1 controls for providing sufficient sleep opportunity are adequate. For instance, if numerous employees report insufficient sleep, the organization should reassess the sleep opportunity provided by the work schedules. On the other hand, if only a few fail to obtain a sufficient sleep, it may be because of non-work related reasons, rather than an issue with the sleep opportunity provided by the work schedule. With appropriate record-keeping procedures, reporting insufficient sleep can help organizations take a performance management approach to employees who consistently report difficulties in this area. The underlying reasons for each case should be investigated. It might be that the employee has a medical problem (e.g., insomnia, physical injury, or a bad cold) or that some life circumstance is negatively affecting sleep (e.g., personal stress, sickness in the family, noisy neighbourhood).

If an employee repeatedly does not take the necessary measures to obtain sufficient sleep, further action may be required. An organization may choose to address the issue using an approach similar to that used for any other problem that may affect performance, such as drug or alcohol abuse. This can be dealt with through discussions with the employee, agreements on measures to be taken, and a series of warnings that could eventually lead to dismissal.
• How much sleep is required by most people to maintain alertness during a work period?
• List two questions you would ask an employee whom you think may not be getting enough sleep. What information would you seek with these questions?
• What actions would you take if an employee has had insufficient sleep?
CHAPTER 7

Level 3 Controls: Assessing Symptoms of Fatigue

Learning Outcomes

On completing this chapter, you will be able to:

• Explain the purpose of including fatigue-related symptom checklists within an FRMS.
• Recognize symptoms of fatigue-related impairment.
• Describe some of the major sleep disorders.
• Outline appropriate action to be taken by a company if an employee is thought to suffer from a sleep disorder.
Level 3 Controls: Assessing Symptoms of Fatigue

Even when sufficient sleep opportunity has been provided (Level 1 controls) and employees feel they have obtained sufficient sleep (Level 2 controls), they may still show fatigue-related symptoms. Level 3 controls assess individual employees for symptoms that could lead to fatigue-related error.

Level 3 controls play two main roles:

1. Identify employees who continue to exhibit fatigue-related symptoms, despite getting sufficient sleep.
2. Assess the effectiveness of Level 1 and 2 controls. For example, where employees fail to report they did not

### Hazard-Control Model for Fatigue Risk Management

<table>
<thead>
<tr>
<th>Hazard Assessment</th>
<th>Error Trajectory</th>
<th>Control Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep opportunity</td>
<td>1</td>
<td>Prescriptive CARs requirements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fatigue modelling</td>
</tr>
<tr>
<td>Sleep obtained</td>
<td>2</td>
<td>Prior sleep/wake data</td>
</tr>
<tr>
<td>Fatigue-related symptoms</td>
<td>3</td>
<td>Symptom checklists Self-reporting behavioural scales Physiological monitoring</td>
</tr>
<tr>
<td>Fatigue-related errors</td>
<td>4</td>
<td>Fatigue-proofing strategies SMS error analysis system</td>
</tr>
<tr>
<td>Fatigue-related incidents</td>
<td>5</td>
<td>SMS incident analysis system</td>
</tr>
</tbody>
</table>
get enough sleep, monitoring for fatigue-related symptoms adds an additional layer of defence.

**Identifying At-Risk Individuals**

Fatigue-related symptoms can be divided into three categories: physical, mental, and emotional. The table below outlines some of the major symptoms under each category. If employees experience three or more of the symptoms outlined below, they may be experiencing some level of fatigue or reduced alertness. Fatigue is not the only cause of the symptoms presented below, but when they occur together it likely indicates fatigue-related impairment.

**An employee who presents three or more symptoms in a short period of time is likely to be experiencing fatigue-related impairment.**

<table>
<thead>
<tr>
<th>Physical Symptoms</th>
<th>Mental Symptoms</th>
<th>Emotional Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yawning</td>
<td>• Difficulty concentrating on tasks</td>
<td>• More quiet or withdrawn than normal</td>
</tr>
<tr>
<td>• Heavy eyelids</td>
<td>• Lapses in attention</td>
<td>• Lacking in energy</td>
</tr>
<tr>
<td>• Eye-rubbing</td>
<td>• Difficulty remembering what you are doing</td>
<td>• Lacking in motivation to do the task well</td>
</tr>
<tr>
<td>• Head drooping</td>
<td>• Failure to communicate important information</td>
<td>• Irritable or grumpy with colleagues, family or friends</td>
</tr>
<tr>
<td>• Microsleeps</td>
<td>• Failure to anticipate events or actions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Accidentally doing the wrong thing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Accidentally not doing the right thing</td>
<td></td>
</tr>
</tbody>
</table>

Many companies teach employees how to identify symptoms, both in themselves and others, that may indicate an increased risk of making a fatigue-related error. Raising awareness about the signs and symptoms of fatigue can be an effective strategy to reduce the number and severity of fatigue-related errors and incidents.

To further reinforce the importance of monitoring fatigue-related symptoms, employees can be provided with aids, such as a checklist to be filled out at the start of every shift, or a wallet-sized card listing the most common symptoms to watch out for.
If employees consistently exhibit fatigue-related behaviour, potential reasons should be investigated. It may simply be that the employee has a personal problem (e.g., sickness in the family, new child or concern, or poor sleeping environment). Employees who say they get enough sleep and cannot explain their fatigue-related symptoms should undergo screening for a sleep disorder. The first step is some kind of paper-based screening, such as a questionnaire, to determine whether they are at risk. At-risk employees should then be referred to a sleep clinic.

Another way to check how fatigued employees feel is to ask them to rate their alertness at various intervals within a shift. The Karolinska Sleepiness Scale\(^3\) can be used to determine whether fatigue is a problem for an individual without determining the root cause for the lack of sleep. As shown below, the scale requires employees to select the statement that best describes them at the time. The scale can be used as an assessment of sleepiness/fatigue at any point in time: at work, while driving, on waking in the morning, etc.

\[\begin{array}{|c|c|c|}
\hline
\text{Fatigue symptom checklist/observed behaviour} & \text{Paper-based sleep disorder screening} & \text{Referral to a sleep clinic for further screening and treatment} \\
\hline
\end{array}\]

**Screening for Sleep Disorders**

**Karolinska Sleepiness Scale**

1. Extremely alert
2. Very alert
3. Alert
4. Rather alert
5. Neither alert nor sleepy
6. Some signs of sleepiness
7. Sleepy, but no effort to keep awake
8. Sleepy, some effort to stay awake
9. Very sleepy, great effort to keep awake, fighting sleep

Employees who report fatigue-related symptoms on a regular basis may have a sleep disorder. An example of a paper-based test to identify the severity of fatigue is the Epworth Sleepiness Scale\(^4\), which asks individuals to determine how likely they are to fall asleep or doze off during a variety of activities. Subjects are instructed to provide answers based on their usual way of life over the past several months. Even if they have not done some of these things recently, they are instructed to try and work out how they might have been affected in each situation. Employees who score above 10 are likely to have problems with their sleep patterns and should be referred to a sleep specialist.

### Epworth Sleepiness Scale

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting &amp; Reading</td>
<td>0 = would never doze</td>
</tr>
<tr>
<td>Watching TV</td>
<td>1 = slight chance of dozing</td>
</tr>
<tr>
<td>Sitting inactive in a public place (e.g. theatre)</td>
<td>2 = moderate chance of dozing</td>
</tr>
<tr>
<td>As a passenger for an hour without a break</td>
<td>3 = high chance of dozing</td>
</tr>
<tr>
<td>Lying down to rest in the afternoon</td>
<td></td>
</tr>
<tr>
<td>Sitting &amp; talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after lunch without alcohol</td>
<td>8-10 = mild sleepiness</td>
</tr>
<tr>
<td>In a car, while stopping for a few minutes in traffic</td>
<td>11-15 = moderate sleepiness</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>16-20 = severe sleepiness</td>
</tr>
</tbody>
</table>
<pre><code>                                    | 21-24 = excessive sleepiness |
</code></pre>

---

There are several types of sleep disorders that affect daytime functioning. A polysomnographic (PSG) recording of sleep at a sleep clinic can help determine the root cause of the fatigue. This process includes analysis of electrical brain activity, eye movements, and breathing throughout the sleep period.

Some of the major sleep disorders are outlined below. Any of these conditions can result in bouts of daytime sleepiness, reduced alertness, and overall lack of energy. Physicians trained in sleep medicine are best equipped to diagnose and treat these problems. A primary care physician should be able to refer clients to a sleep specialist for evaluation, diagnosis, and treatment.

**Insomnia**

Insomnia is a disorder characterized by difficulty falling or staying asleep, and/or frequent awakenings during the sleep period. There are a number of factors that may contribute to insomnia, including (but not limited to):

- short-term or long-term stress such as trauma or chronic illness
- psychological condition
- the presence of another sleep disorder
- poor sleep hygiene (i.e., not following good sleep practices)

**Sleep Apnea**

Sleep apnea causes a person to stop breathing for brief periods several times during sleep. This condition can affect all ages and both genders, but it is most common in men and is particularly prevalent in obese people. The disorder exists in two forms:

1. **Obstructive sleep apnea** is the most common and occurs when the airways close while a person is sleeping, blocking the flow of air and preventing adequate oxygen flow to the body. This awakens the sleeper many times a night, disrupting the normal structure of sleep, and resulting in sleepiness and reduced alertness at work.

2. **Central sleep apnea** is less common and occurs when muscles required for breathing do not receive a signal from the brain, causing the sleeper to stop breathing.

Untreated sleep apnea can lead to cardiovascular tissue damage caused by reduced oxygen levels and can lead to excessive sleepiness when a person is awake. Excessive sleepiness can lead to accidents and injuries, particularly while driving or operating safety sensitive systems.

**Restless Leg Syndrome and Periodic Limb Movement**

Restless Leg Syndrome and Periodic Limb Movement are sleep disorders that are characterized by involuntary limb movements, usually a leg, many times over the course of a night. Movements can occur as often as every 10 seconds, disrupting sleep and leaving the individual suffering significant daytime sleepiness.
Narcolepsy

Narcolepsy is characterized by a sudden irresistible desire to go to sleep that lasts from minutes to hours at a time. It is associated with cataplexy (the sudden loss of tone in one or more muscle groups) and with vivid auditory or visual hallucinations when falling asleep. This is understood to be a malfunction of the mechanism that controls rapid eye movement (dreaming) sleep. Excessive daytime sleepiness and the tendency to fall asleep uncontrollably may render individuals unable to carry on working, and may put themselves or others at risk.

Sleep Clinics

An employee suspected of having a sleep disorder should be encouraged to consult a sleep specialist. Usually, the employee will need a doctor’s referral. The Canadian Sleep Society offers a list of sleep medicine clinics in Canada: www.css.to/sleep/centers.htm.

Assessing the effectiveness of other levels of control

In Chapter 6, we discussed Level 2 controls (i.e., obtaining sufficient sleep) as they related to Level 1 controls (providing sufficient sleep opportunity). We established that assessing the actual amount of sleep obtained provides a measure of how effective the Level 1 controls are in providing sufficient sleep opportunity. In the same way, Level 3 controls offer a way to measure the effectiveness of the two previous levels of control.

In Chapter 2 we discussed organizational and individual responsibilities in managing fatigue. The organizational responsibilities included two subcomponents:

1. Fatigue related to hours of work
2. Fatigue related to workload and environment

Fatigue related to hours of work should be managed by providing employees with sufficient sleep opportunity between shifts (Level 1 controls). Assessing actual hours of sleep (Level 2 controls) lets you double-check that sleep opportunity is sufficient.

Some employees may find it difficult to quantify how much sleep they actually get, particularly if sleep is disturbed. Some may also choose to be dishonest about the actual amount of sleep they obtain and fail to report when they may be at risk of fatigue-related error. Level 3 controls (monitoring for fatigue-related behaviours or symptoms) provide a further check to ensure that sufficient sleep opportunity has been provided (Level 1) and that employees are obtaining sufficient sleep (Level 2).

The tasks involved in a job can significantly affect fatigue. Some tasks are more fatiguing than others. As shown in the figure below, this can occur at both ends of the spectrum – mundane tasks can be just as fatiguing as highly complex, demanding tasks.
Similarly, some aspects of the work environment can affect fatigue more than others. For example, fatigue-related behaviour tends to be more prevalent in workplaces that have high levels of vibration or noise, or high temperatures. The level of lighting (lux) in a workplace can also affect fatigue. Since these factors would not be identified in the Level 1 or 2 controls, watching for specific fatigue-related symptoms in the workplace provides an additional level of control to further enhance the safety management system.

**EXERCISE**

- Describe the role of Level 3 controls in an FRMS.
- List seven signs or symptoms of fatigue.
- Describe two of the major sleep disorders.
Learning Outcomes

On completing this chapter, you will be able to:

• Choose fatigue-proofing strategies that would be useful for your organization.
• Understand the reasons why most organizations’ incident and accident investigation procedures do not properly identify fatigue as a contributing factor in a specific event.
• Identify the two necessary conditions that define an event as a fatigue-related incident or accident.
• Outline specific trends that can be assessed to identify potential patterns between incident and accident data and fatigue factors.
Even with strict controls in place, it is still possible that fatigue-related errors could occur and result in incidents or accidents. Level 4 and 5 controls are designed to further reduce fatigue-related risk.

**Level 4: Fatigue-Proofing Strategies**

The goal of an FRMS should be to reduce fatigue levels as much as reasonably possible. Achieving this goal involves focussing on the time available for sleep.
(or sleep opportunity) and actual sleep obtained. However, it is important to acknowledge that it is not possible to completely eliminate fatigue from all workplaces all of the time. Employees and managers should also understand that a certain amount of fatigue in the workplace may be acceptable, provided the risks are managed.

Many organizations supplement fatigue reduction strategies with fatigue-proofing strategies. Both types of countermeasures are important defences against latent failures – a series of breakdowns in the system that build up to create the conditions for an incident. They also act to further reduce the risk of active failures – the direct causes of an incident.

Once an analysis of the work schedule has been completed using work design principles, computer-modelling techniques, assessment of sleep patterns, or other approaches, the organization can target the areas of highest fatigue in the schedule with fatigue-proofing strategies. This approach encompasses four main components, including:

- “double-checking” to increase the likelihood of detecting errors
- improving the work environment to reduce risk
- scheduling less complex or less safety-critical tasks at times of highest fatigue risk
- training employees about personal limitations and strategies to increase alertness

More specific examples of fatigue-proofing strategies might include:

**Double-Checking**

- close supervision
- working in pairs or teams depending on the task
- task rotation
- checklists
- self-assessment checklists for signs and symptoms of fatigue
- support for new personnel by experienced personnel
- self-reporting systems
- communication/briefings at shift handovers (written/verbal/face-to-face)

**Work Environment**

- self-selected break times
- interaction with peers
- provision of appropriate facilities for break time: lunch room, access to vending machines with healthy snacks, caffeinated drinks, etc.
- napping facility in a quiet environment
- appropriate lighting
- control over temperature
- vibration management
- car pooling (minimize driving alone on commute)
- provision of transport (bus, taxi, etc.) for personnel for commutes after overtime (longer or extended shifts; call-ins, etc.)
A better understanding of fatigue risks and how they contribute to hazards in operational environments now makes it possible to include an assessment of fatigue and shift work as part of the investigation process.

It is now generally held that for an incident or accident to be defined as fatigue-related, it must have both:

- occurred in the presence of fatigue
- been consistent with fatigue-related error (i.e., caused by falling asleep, inattention, delayed reaction time, error in judgement, etc.)

Defining an event as fatigue-related should involve a review of the first three levels of fatigue risk control. This permits determining whether:

- the work schedule provided sufficient sleep opportunity for the employee
- the employee actually obtained sufficient sleep
- fatigue-related symptoms were observed prior to the event

The results of this review should allow you to determine whether fatigue may have been involved and to identify weaknesses in the fatigue-risk control measures in place in the organization.

Many companies analyse information from individual incident reports as well as other company sources. For example, the incident investigation process might require asking employees whether they have recently used medications known to have an effect on alertness. Or they may

### Scheduling Less Complex or Less Safety-Critical Tasks

- ensure high-risk activities are conducted during the day, rather than at night, where possible
- rotate tasks
- avoid boring and mundane tasks at times of higher risk for fatigue
- maintain appropriate staffing levels
- avoid highly complex tasks at times of higher risk for fatigue

### Training Programs and Topics

- fatigue awareness/competency training
- refresher training and capacity building
- training on maximizing sleep and alertness
- information for families/housemates on facilitating sleep at home
- awareness about the impact of food and hydration on alertness
- physical activity
- appropriate use of stimulants such as NoDoze
- availability of caffeine

### Level 5: Incident Investigation – Asking the Right Questions

Incidents and accidents that an organization records for safety audits may include errors, near-hits (or near-misses), lost-time injuries, medically treated injuries, breaches of policy or procedure, etc. While error and incident reporting is common, until recently few reporting procedures systematically examined whether fatigue was a contributing factor.
be asked about the most recent break during the shift – how long was it and when did it occur? Other organizational information might include hours worked on the day of the incident and during the previous week.

The questions asked during an investigation can help determine whether a specific factor contributed to an incident. To get a clear understanding of whether fatigue contributed to an incident or accident, investigators must ask sufficient questions, and specific questions. By collecting pertinent information about fatigue, the company can improve understanding of its own fatigue risk and adjust its procedures to reduce that risk.

The list below provides a range of general questions that might be included. This is not intended to be an exhaustive list for all organizations. Each question is linked to the various levels of FRMS control, which can allow an organization to identify where corrective measures may be needed. Bear in mind that even if no evidence of fatigue is found in the answers to the questions, fatigue may still have been a factor – there are many contributors to fatigue and further probing may be necessary.

Sample questions:

1. What was the date and time of the incident/accident?
2. What were the planned hours of work for each employee involved in the incident/accident over the two weeks prior to the incident? [Level 1 controls]

3. What were the actual hours of work of employees involved in the incident/accident over the two weeks prior to the incident? [Level 2 controls]
4. What were the reasons for any additional hours worked beyond the planned hours during this period? Specifically, was the extra work or overtime foreseeable in advance and how was it allocated among all eligible employees? [Level 2 controls]
5. How many hours sleep did each employee involved in the incident/accident recall having obtained in the 24 and 48 hours prior to the event? [Level 2 controls]
6. How long had each employee involved been awake at the time of the incident/accident? [Level 2 controls]
7. Were any of the employees observed falling asleep or otherwise struggling to remain alert in the week prior to the incident/accident? If yes, document details. [Level 3 controls]
8. Does anyone involved in the incident recall having unexpectedly fallen asleep or otherwise struggling to remain alert during the week prior to the incident/accident? If yes, document details. [Level 3 controls]
9. Did anyone involved in the incident/accident take medications or drugs (prescription or non-prescription) in the week prior to the event? If yes, then document details and note any effect the medication or drug is known to have on sleep, alertness, and/or fatigue. [Level 3 controls]
10. Was any employee involved aware of any sleep or other medical disorder that might have affected sleep, alertness, and/or fatigue? If yes, document details. [Level 3 controls]
11. Was any employee involved aware of any personal, financial, or other stress that might have affected sleep, alertness, and/or fatigue? If yes, then is this stress ongoing? Document details.

12. Did any employee involved have another job or significant responsibility in the preceding two weeks? If yes, document details.

13. Approximately how many minutes is the commute to and from work for each employee involved in the incident or accident?

Answers to some of these questions may identify areas that need to be probed further. For instance, if the answers to questions related to Level 2 controls indicate that insufficient sleep was obtained, any measures that were taken to mitigate fatigue risk should be re-examined (as discussed in Chapter 6).

By assessing the information collected using such questions, companies can gain a much clearer understanding of whether fatigue contributed to an incident or accident. Over time, results of investigations can be used to examine trends between incidents/accidents and time of day, day of week, time of year, amount of overtime, commute distance, age of employee, presence of stressors, and other relevant factors. Properly collected incident and accident investigation data can permit the company to develop more stringent and targeted controls to reduce the risk of further accidents.

**EXERCISE**

- List five fatigue-proofing strategies that would be practical for your organization.
- Discuss why many organizations’ incident and accident investigation processes are inadequate for assessing the contribution of fatigue.
- List the two necessary conditions to define an event as a fatigue-related incident or accident.
- List at least two incident or accident investigations in your organization that identified fatigue as a possible contributor. Detail any specific fatigue-related factors, such as schedule, hours worked, and symptoms of fatigue observed. If there are no recorded events identified with fatigue, comment on the likely effectiveness of your organization’s system to measure relevant fatigue factors.
- Given the nature of the operations on the site(s) where you work, discuss areas that you believe would be most susceptible to fatigue-related risks and why.
- Outline specific trends that could be investigated to identify potential patterns between incident and accident data and fatigue factors.
Learning Outcomes

On completing this chapter, you will be able to:

- Detail the fatigue-risk management factors that are assessed during internal audits.
The components that make up a fatigue risk management system will evolve over time as additional information is collected and assessed through normal operations or through investigations into incidents or events. This chapter outlines the kinds of information that can be useful for conducting an internal audit of the company’s fatigue risk management system. Sample questions have been provided that make it possible for individuals or groups who are not necessarily fatigue risk experts to perform the audit. While other stakeholders such as regulators may require additional data for their own purposes, the questions provided below can act as a useful starting point.

Ideally, an internal FRMS audit should be conducted one year after the initial implementation, and every two years after that. Internal audits are generally conducted by the safety manager or by an external consultant. However, it is essential that employees be involved in the audit process to obtain their perceptions of how the FRMS is working. After the review, senior management and the FRMS committee should meet to review and discuss the findings and plan any potential changes to the FRMS.

### Policy

Used to define fatigue and to outline responsibilities of the employer as well as employees.

- Has a fatigue policy been developed?
- Does the policy clearly detail individual responsibilities of the employer and employee (may also include clients and contractors) in managing fatigue?
- Does the policy specifically help employees, supervisors and managers understand (1) the significance of fatigue management, and (2) their role in keeping levels of fatigue within acceptable levels in the workplace? Has the policy manual been shared with all relevant stakeholders for comment and final approval?
- Has the policy implementation date been chosen or has the policy actually been implemented?
- Has the policy also been applied to contractors who work on-site?
Developing and Implementing a Fatigue Risk Management System

FRMS Committee (or person responsible for the FRMS)

Tasked with the review and guidance of company matters relating to fatigue.

- Has an FRMS committee been established? Or has it been incorporated into a more general safety committee? Or has a person been designated as responsible for the FRMS?
- Does the committee represent all the key stakeholders – for example, operators, supervisors, managers, maintenance and safety personnel, union representatives, as well as trainers?
- Has the FRMS committee (or person responsible for the FRMS) been provided with the resources, information, and technical support to perform its required role?
- Has the FRMS committee (or person responsible for the FRMS) identified major fatigue-related issues, problems, and strengths related to fatigue management in the organization and subsequently developed a fatigue management plan?
- Does this plan deal specifically with training and education, scheduling guidelines, risk management, workforce planning, as well as management training and activities?

Communication and Consultation

To keep all stakeholders informed of the fatigue management process and its progress (may be developed by the FRMS committee or a pre-existing group).

- Have all reasonable methods for communicating to stakeholders been assessed for effectiveness and cost benefit (for example, face-to-face training, e-mail, safety newsletters, posters in the workplace)?
- Have stakeholders been provided with the policy, hours of work guidelines, information about training and education, as well as sources of additional information?
- Have stakeholders been consulted about the implementation of the FRMS? What did the consultation process involve? How did the organization consider each group's point of view in establishing the final FRMS?

Implementation Process

The step-by-step process and schedule for implementation.

- Have supervisors, managers, and those who supervise or manage on-site contractors been trained in the implementation and use of the fatigue management system? Do company management, supervisors, and employee representatives have the skills to implement and manage the FRMS?
- Have all parties received information and procedures for managing fatigue according to the policies and guidelines?
- Have training sessions or workshops been conducted to address any questions and to discuss possible scenarios?
- Has resource material been provided to support these employees after the session?
Schedules and Actual Hours of Work

Where “acceptable” balances safety, operational, and general risk concerns with social requirements.

- Has a scheduling guideline been developed that meets both organizational requirements and fatigue risk management principles?
- Were stakeholders consulted and asked to provide feedback regarding the FRMS scheduling guidelines?
- Were stakeholders provided with adequate information about the specific fatigue implications of various shift structures?
- Has a date been set to implement the scheduling guidelines or have they already been implemented?
- Have specific criteria been developed to manage the effect of overtime, leave and vacation, start and finish times of shifts, and commuting to and from work?
- Has a fatigue assessment tool been used to predict fatigue levels associated with the hours of work? Have the scheduling guidelines been applied to contractors work on site?

Assessment of Actual Sleep Obtained

To ensure that there is a process to be followed if an employee does not feel safe to start or continue work. Ideally, this should be non-punitive.

- Has fatigue been formally recognized as a legitimate reason for employees to stop work and/or request a break?

- Has a system been developed to manage reports of fatigue? What is the system?
- Was the workforce able to participate in the planning and development of the self-disclosure system?
- Has the fatigue self-disclosure system been used? How many reports have been processed over the last week/month/six months/year? (No reports of fatigue over a number of months may indicate that the organizational culture does not yet support the system.)
- Has any employee reported fatigue on so many occasions that it is considered excessive? (It is important that such cases be managed carefully and appropriately and that a clear definition of excessive be in place.)
- Has the FRMS committee or other relevant pre-existing group developed procedures to help supervisors deal with employees who report that they are fatigued?

Development of Training Program

To determine whether appropriate training materials are developed.

- Who is responsible for developing/presenting training materials to employees?
- What are the key components of the training?
- If training materials were developed in-house, was the person or group provided with adequate reference material, financial resources, and support to complete the job to an acceptable standard?
– Have adult learning principles and competency-based training methods been used?
– Were the people who developed the training adequately qualified and/or experienced to develop a fatigue-related program?
– Have the materials been tested and reviewed by groups of employees?

Delivery of Training

To ensure that specific and targeted training occurs using suitably qualified and experienced trainers.

• Are trainers appropriately qualified and experienced? (Experience with shiftwork is a significant advantage)
• Have trainers been involved, or at least fully briefed, in the development of learning outcomes, lesson plans, and other aspects of the training requirements? (For material developed in-house)
• Have trainers been supplied with, or provided access to, reference materials to help answer a wide range of related questions?
• Have trainers been supplied with evaluation forms so that training can be improved?
• Is a training register kept as a record that employees have completed their training?

Incident and Accident Investigation

To update procedures to ensure that fatigue is included as a potential factor to be investigated.

• Has the existing incident and accident investigation process been fully reviewed to determine whether it adequately identifies potential fatigue-related issues?
• Does the process collect data relating to work and non-work related factors that may contribute to fatigue?
• Have incident/accident investigation and training procedures been updated?

Internal Audits

To keep accurate records of implementation for reporting purposes and audits by any outside parties such as regulators.

• Does the internal audit system assess all relevant components of the fatigue management system? (At a minimum, this should include policy, training, hazard control, and audit.)
• Are there additional assessments that might provide valuable information for the organization? If yes, provide details.
• Has a survey or other consultation been conducted within the organization and with any relevant contractors to consider the adequacy of the process and level of impact of the fatigue management system?
• Are follow-up assessments made of training delivery, compliance with scheduling guidelines, implementation schedules, and other parts of the fatigue management implementation?

While the list above suggests that an audit consists of a number of distinct and independent reviews, it should not be forgotten that each component is part of an overall, interactive system.
• Discuss the benefits of conducting fatigue management internal audits.
• List six aspects of an FRMS that should be assessed during an audit.
• Provide at least three key questions for three of these aspects that should be asked during a thorough internal audit assessment.
• List the departments and/or individuals or groups that need to be involved in the review and update of the incident and accident investigation system as well as the internal audit system.
Resources


Canadian Health Network website: www.canadian-health-network.ca/


National Sleep Foundation website: www.sleepfoundation.org


Talk about Sleep website: www.talkaboutsleep.com
Fatigue Risk Management System
for the Canadian Aviation Industry

Policies and Procedures
Development Guidelines

April 2007
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Notices

This report reflects the views of the authors and not necessarily the official views or policies of Transport Canada.

Transport Canada does not endorse products or manufacturers. Trade or manufacturers’ names appear in this report only because they are essential to its objectives.

Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Lignes directrices pour l’élaboration de politiques et de procédures», TP 14576F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adelaide, Australia.

The FRMS toolbox consists of six components:

1. FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue, TP 14572E: introductory material intended to raise awareness about fatigue

2. FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. FRMS for the Canadian Aviation Industry: Employee Training Assessment, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. FRMS for the Canadian Aviation Industry: Trainer’s Handbook, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
## Contents

**How to Use this Guide** ................................................................. 1

1. **Introduction** ................................................................. 3  
   1.1 Preamble ................................................................. 3  
   1.2 Document Control ...................................................... 5  
   1.3 Definitions and Abbreviations ...................................... 6  
   1.4 Relevant Operational Publications .............................. 10

2. **Manual Control and Organization** .................................... 11  
   2.1 Company Operations ................................................. 11  
   2.2 Outline of Organizational Structure ............................ 12  
   2.3 Responsibilities of Company Personnel ...................... 13

3. **Fatigue Risk Management System** .................................. 17  
   3.1 Preface ................................................................. 17  
   3.2 FRMS Policy .......................................................... 19  
   3.3 Hours of Service and Scheduling .............................. 24  
   3.4 Verification of Actual Sleep ..................................... 29  
   3.5 Fatigue-Related Symptoms ....................................... 36  
   3.6 Fatigue-Proofing Strategies .................................... 40  
   3.7 Reporting Protocols ................................................. 44

4. **Training and Education** .................................................. 47

5. **Review and Improvement Process** ................................... 51

6. **Appendices** ................................................................. 55

7. **Further Reading** .......................................................... 59
How to Use this Guide

A fatigue risk management system (FRMS) is an integrated set of management policies, procedures, and practices for monitoring and improving the safety and health aspects related to fatigue within your organization. This guide is intended to help you to build an effective fatigue risk management policies and procedures manual tailored to your specific operational requirements. Such a manual should provide both the overall governance policy for fatigue risk management, as well as a detailed framework for how fatigue will be managed on a day-to-day basis within the workplace.

Implementing an FRMS does not mean you need to create another set of documents. Some aspects of the policy may already be covered in your safety management system (SMS) manual. If this is the case, just cross-reference or copy the information in your FRMS manual.

In accordance with Canadian Aviation Regulations (CARs), the FRMS manual must clearly define:

- the level of senior management commitment
- the purpose and goals of the FRMS
- responsibilities of all employees for managing fatigue risk
- training requirements
- reporting procedures for fatigue-related hazards
- the fatigue reporting policy (any punitive actions that may be taken as a result of non-compliance, for example)
- a procedure for evaluation and continuous improvement of the FRMS.

This approach is in line with Transport Canada’s guide to implementing a safety management system: Safety Management Systems for Flight Operations And Aircraft Maintenance Organizations — A Guide to Implementation (TP13881E).

Each section of this guide has three components:

- Introduction — information about the purpose, theory and framework of the given FRMS policy component
- Points to consider — a summary of the main points to be covered in that section of the manual. These have been framed as questions, which can be used as a framework for discussing
the core components of an FRMS in consultation workshops.

- Sample text — examples of what might be included in the given policy component section. These examples have been provided so that organizations can see the style of phrasing and content acceptable to Transport Canada. Each section of your policy manual should be tailored to the specific needs of your organization.

Each section of this FRMS guide is labelled as either mandatory or recommended:

- mandatory sections must be included in your document. The sample text provided in this guide should be reviewed and modified appropriately to suit your operation.

- recommended sections should be discussed with employees or your FRMS committee to determine whether they are appropriate and how they should be adapted to meet your operational requirements.

This guide follows the same organizational structure recommended for the FRMS policies and procedures manual.
1.1 **Preamble (Mandatory)**

The FRMS manual should include clearly defined policies, procedures, and practices to ensure that the risk of fatigue-related error is reduced as much as possible. The FRMS should be tailored to your operation. To ensure maximum effectiveness of your FRMS, the manual must reflect what you actually do.

The aim of implementing an FRMS is to institute a change in organizational culture that results in enhanced flight safety and a safer working environment. It is essential that organizations do not simply paraphrase generic FRMS policy statements but take the time to write their own. The FRMS manual should be used as the primary means of communicating to employees the FRMS policies and procedures to be followed as part of regular operations.

You should review and update the FRMS manual one year after implementation, and on a set schedule thereafter (e.g., every two years). You will need to include a control process for amending documentation as per CAR documentation requirements.

**Points to Consider**

- Why is the organization implementing an FRMS?
- Who will be affected by implementation of the FRMS?
- What are the basic responsibilities of employees within the FRMS?
- How often will the FRMS policy be reviewed and updated?
Section 1.1  Preamble (Mandatory)

- This FRMS manual is required by Part V of the Canadian Aviation Regulations (CARs) for [insert company name] trading as [insert trading name if applicable]. This manual applies to all personnel employed by the company in any capacity (full time, part time, casual, or contract). All personnel shall abide by the procedures contained in this manual.

The CARs must be observed at all times whether or not they are specifically referred to herein. Should conflict occur between this document and the CARs, this manual will be regarded as secondary.

The FRMS manual will be made available to and read by all personnel employed by [insert company name]. Each employee is required to sign the Amendment Awareness Record in the master copy held by the person responsible for the FRMS. This signature shall be regarded as proof that the employee has read and understood the FRMS policy, and will act in accordance with procedures outlined in the manual. The FRMS policy will be reviewed one year after implementation or at an interval acceptable to Transport Canada, and at least every two years thereafter to ensure the relevance and currency of all procedures. Accordingly, the person responsible for the FRMS shall sign and date the review record in the master copy showing that the review was completed and indicating whether amendments were made.

- The Fatigue Risk Management System (FRMS) policies and procedures manual provides [insert company name] employees with comprehensive directions concerning the handling of fatigue-related risk within the operational environment.

The FRMS policies and procedures manual will be provided to everyone within the organization upon request. A revised amendment sheet will be issued with each amendment.

The person responsible for the FRMS shall review the FRMS policy one year after initial implementation, and at least every two years thereafter.
1.2 Document Control  
(Mandatory)

All Canadian civil aviation certificate holders are required by the CARs to amend the FRMS manual whenever it is necessary to do so. You should systematically create, circulate, and record any amendments to the FRMS policy. You may choose to use your current procedure for this or the one described in the sample text below. This text provides a basic amendment process for a simple FRMS manual. You may wish to add extra controls suitable for the size or complexity of your operation.

Points to Consider

- How will amendments to the FRMS policy be recorded?
- How will employees be informed about FRMS policy amendments?
- How will employee understanding of FRMS policy amendments be recorded?

SAMPLE TEXT

Section 1.2 Document Control (Mandatory)

The person responsible for the FRMS shall create and distribute amendments to the organization’s FRMS policy. Line managers will be responsible for discussing details of FRMS policy amendments with employees at team safety meetings.

Once issued, the amendment shall be distributed according to the manual distribution list. The amendment number, date, policy section amended, description of changes, signature, and entry date shall be recorded in the appropriate place.

To maintain the integrity of the manual and to monitor amendments, the manual shall include a list of effective pages — pages that have been or may be amended and the date that they were last modified:

- List of effective pages
- Signature sheet
- List of parts
- Tables of contents for each part and section

All employees associated with [insert company names]’s FRMS must sign the Amendment Awareness Record as evidence of having read, understood and agreed to apply the procedures contained in the FRMS policy. All personnel who are required to sign must do so on joining the organization, and whenever an amendment has been made. It is the responsibility of the person responsible for the FRMS to ensure that each amendment is brought to the attention of all relevant persons.
1.3 Definitions and Abbreviations  
(Mandatory)

It is important to provide employees with clear definitions of key concepts in the FRMS policy. This helps the organization to avoid confusion and function with clear goals. If the content of this section is covered in your SMS manual, you may chose to simply cross-reference it here rather than repeating the information.

Define the meaning of words and phrases unique to the FRMS policy only. For example, you may want to define the terms “management,” “competent person,” and “responsible person.” Any terms or titles that you introduce in the manual should be defined here.

You must define “company” (operator/organization) as the legal entity referred to throughout the manual.

You may wish to include references or other information sources in this section.

Points to Consider

• What terms used in the FRMS policy could be ambiguous or unknown to the user?
• What words are likely to recur throughout the document as acronyms?

SAMPLE TEXT

Section 1.3 Definitions and Abbreviations (Mandatory)

All definitions contained in the CARs, the Aeronautical Information Publications, and the Transport Canada website apply wherever they appear in this document. The following definitions are provided for users’ convenience:

DEFINITIONS

Accountable Executive — The individual responsible for operations or activities authorized under the civil aviation certificate and accountable for meeting the requirements of the Canadian Aviation Regulations (CARs). The accountable executive must have full control of the financial and human resources necessary for the activities and operations authorized under the certificate.

Actigraph — A small watch-like device worn on the wrist to measure movement and infer sleep/wake activity

Aerodrome — A defined area of land or water including any buildings, installations and equipment intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft
**Body Mass Index (BMI)** — Used to define nutritional status and is derived from the formula: weight (kg)/height (m)² or weight in kilograms divided by the square of height in metres. The standards are the same for men and women. The normal healthy range is 20-25. Obesity is taken to start at a BMI of 30 and gross obesity at 40. A BMI of 18-20 is defined as mild starvation and severe starvation begins when BMI falls below 16.

**Circadian rhythm** — Human beings are programmed to sleep during the night and to be active during the day. The sleep/wake cycle is a circadian rhythm. The term circadian comes from two Latin words, circa (about) and diem (a day). Thus, circadian rhythms refer to physiological functions that cycle over a day. Examples are the sleep/wake cycle, alertness and performance, body temperature, production of hormones like melatonin and cortisol, and heart rate. These rhythms are regulated by a biological clock in our brains. Circadian rhythms do not generally adjust easily to shift work.

**Commute time** — The time it takes for employees to travel between their workplace and home

**Company** — The term “company” is used generically, and may include a council, an individual, or a company.

**Error** — A safety-critical event that does not result in equipment damage, injury or death, but could potentially do so in different circumstances.

**Facility** — Premises used for the operation of aircraft on an aerodrome. These premises may be fixed or portable, and may include communication facilities.

**Fatigue** — An increased level of sleepiness associated with impaired cognitive and/or physical functioning that may, as a consequence, result in an elevated risk of error or accident. For the purposes of this policy, fatigue is due primarily to increased duration of wakefulness and/or reduced duration of sleep.

**Fatigue audit** — Where an electronic or manual tool is used to calculate the relative sleep opportunity for an “average” individual using work schedules as the primary data source.

**Fatigue Audit InterDyne (FAID)** — A commercial software package that calculates the relative sleep opportunity for a hypothetical “average” individual using scheduled working hours as the primary data input. The sleep opportunity (or FAID) score at any particular time is a weighted aggregate based on the timing and duration of work and non-work periods, the time of day when these occur, and social and family factors that may influence the propensity to sleep. Typically the result is expressed as a score between 0-150. Scores below
a task-specific threshold are generally considered to provide an adequate sleep opportunity. Scores over the threshold are generally considered to provide a reduced sleep opportunity and require significant additional levels of hazard control. In general the level of control required is proportional to the degree to which the FAID score exceeds the threshold.

**Fatigue or error proofing** — Strategies to reduce the likelihood or consequence of an incident when employees are required to work through periods of high fatigue

**Fatigue reduction** — Strategies to reduce the likelihood of employees being at risk of making a fatigue-related error while at work

**Person responsible for the FRMS** — Person(s) with specific responsibilities under this document

**Hazard** — A source of potential error, incident, or situation with a potential to cause damage to equipment or result in injury or death

**Incident** — A safety-critical event that results in equipment damage, injury, or death

**Legal entity** — A person having legal personality (capable of enjoying and being subject to legal rights and duties). A legal entity may be:

- a natural person, or a group of natural persons
- an incorporated company or association, or a group of such companies or associations
- a body, corporate or politic, created by statute

**Non-work related causes of fatigue** — Factors contributing to a state of fatigue for which an individual employee is primarily responsible

**Organization** — Has the same meaning as “company”

**Operator** — Has the same meaning as “company”

**Owner** — The legal entity holding the Civil Aviation Document (CAD)

**Policy** — Refers to the current FRMS policies and procedures document

**Recovery sleep** — The sleep obtained away from the workplace enables the employee to recuperate from the work period and begin to pay back any sleep debt accumulated while on shift.

**Regulator** — Transport Canada
**Risk** — A calculation of consequence (potential loss) and likelihood (probability/frequency) of a potential incident

**Shift work** — Any work schedule that requires the employee to work at night (between 9 p.m. and 7 a.m.), in the afternoon/evening (after 5 p.m.), weekends (Saturdays/Sundays), very early hours (pre 6 a.m. starts), or longer than eight hours (including managers with flexible schedules that may require them to take work home, come in early and go home late, be on call, and carry a pager they never turn off).

**Sleep** — A reversible state of perceptual disengagement from, and unresponsiveness to, the environment.

**Sleep apnea** — A respiratory sleep disorder that causes multiple awakenings during sleep and, as a consequence, reduces the recuperative value of sleep and increases levels of fatigue. In severe cases it has also been associated with significant cardiovascular disease and long-term health problems.

**Sleep debt** — Occurs when an employee does not obtain adequate restorative sleep. A sleep debt can accumulate over a period of days. This debt may result in impaired performance, reduced alertness, and higher levels of sleepiness and fatigue. A sleep debt can only be repaid with recovery sleep.

**Sleep deprivation** — Loss of sleep that can occur either acutely (loss of a complete night’s sleep) or partially (some sleep lost each night over a period of nights). Both result in reduced levels of alertness and performance.

**Sleep duration** — The period between the onset of sleep and waking, less awakenings.

**Sleep inertia** — The impairing effect of sleep on cognitive performance immediately after waking up.

**Sleep opportunity** — The time during a 24-hour period that a person has available for sleep. Hours of work together with commute times generally dictate the duration of sleep opportunity. Scheduling and type of work dictates whether the sleep opportunity is regular, irregular, predictable, or unpredictable.

**Sleep length** — The total amount of sleep obtained during each sleep period.

**Sufficient sleep** — The average person requires 6 hours sleep per night before experiencing fatigue-related performance decrements.
1.4 Relevant Operational Publications

This section is required when additional documents are relevant to your FRMS. You may wish to include references to regulatory material cited in this manual.

NOTE: If data such as accident statistics are included, they must be kept up to date.

Points to Consider

• Does the FRMS manual refer to any existing regulatory material or company documents?

SAMPLE TEXT

Section 1.4 Relevant Operational Publications (Mandatory)

This manual makes reference to the following Transport Canada publications:

• The Canadian Aviation Regulations (CARs)
CHAPTER 2

Manual Control and Organization

2.1 Company Operations
(Mandatory)

You must provide details of the legal entity (as shown on your Civil Aviation Document) and its trading name (if applicable) in the opening paragraph. A copy of this FRMS policy manual must be placed at each location identified in the distribution list (see Section 1.2).

If the content of this section is already covered in your SMS documentation, you may chose to simply cross-reference it here rather than repeating the information.

Points to Consider

• What is the legal and contact information of the company referred to in this FRMS policy (i.e., address, telephone, fax, e-mail, website, operating certificate, operating licence number)?

SAMPLE TEXT

Section 2.1 Company Operations (Mandatory)

The legal entity referred to in this FRMS policy manual is the operator of [insert company name]. The organization’s coordinates are shown below:

• Address on Civil Aviation Document
• Postal Address
• Telephone
• Fax
• E-mail

A copy of the company’s Civil Aviation Document (CAD) is attached in Appendix X of this manual or a copy of the company’s Civil Aviation Document (CAD) is included in section X of the SMS manual.
2.2 Outline of Organizational Structure (Mandatory)

You must provide an outline of your organizational structure. If you have provided this information in your operations or SMS manual, you may refer to it here, remembering that you must add the position of “person responsible for the FRMS” and/or “FRMS Committee.” The information may be provided in text or table format.

You must also include a reference to the legal entity named in Section 2.1 who holds the CAD to which this FRMS policy applies. The name of the legal entity should be the same as listed on the CAD.

Note: if any information changes, such as the company address, you are required to amend your SMS manual and notify Transport Canada accordingly.

You must state that this manual is available for Transport Canada’s inspection at the location specified in Section 1.2.

Points to Consider

- How many layers of management are there in the hierarchy of the organization?
- Who is directly responsible for each group of employees?
- Where does fatigue risk management fit within the organizational structure?
- How is the accountable executive notified of fatigue-related issues?

SAMPLE TEXT

Section 2.2 Outline of Organizational Structure (Mandatory)

This organization operates with the positions described below. A reporting structure is implied by the arrangement of the names in this structure, i.e., each position reports to and is accountable to the position immediately above.

Accountable Executive

- Director of Flight Ops
- Person Responsible for Maintenance (PRM)
- QA Manager 1
- SMS Manager
- Person Responsible for FRMS

- Person Responsible for FRMS
- QA Manager 1
- SMS Manager 2

Fatigue Risk Management System for the Canadian Aviation Industry
2.3 Responsibilities of Company Personnel (Mandatory)

You must ensure that responsibilities for fatigue risk management are specified in the organizational structure. This is likely to include:

- Safety Manager
- Person responsible for the FRMS
- The SMS/FRMS Committee
- Employees

If there are other positions in the organization with responsibilities related to the FRMS, they should be included here. You may choose to define the roles and responsibilities of those positions here or elsewhere in the document, cross referencing them to this section.

The person responsible for FRMS may be the Accountable Executive, the person responsible for maintenance, or — in a small organization — the director of flight operations. In larger organizations, responsibility is likely delegated to a specific position, individual, or committee. It is important, however, to designate one person as having primary responsibility for directing the FRMS.

The responsibilities of each position under the FRMS should be outlined here. You can add the responsibilities of employees to the organization chart, or you can add them in point form below the chart.

Points to Consider

- What are the specific duties and responsibilities of each subgroup of employees for managing fatigue within the context of the FRMS?
- How do those responsibilities fit within the organizational structure?

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SAMPLE TEXT

Section 2.3 Responsibilities of Company Personnel (Mandatory)

ACCOUNTABLE EXECUTIVE

The Accountable Executive is responsible for oversight of minimizing the risks associated with work-related fatigue. Accordingly, the Accountable Executive will:

- encourage a workplace culture to manage fatigue-related risk effectively
- advise Transport Canada of any changes to the FRMS policy
- provide oversight and direction to the person responsible for the FRMS and/or committee during FRMS design, implementation, and review
- provide appropriate resources to effectively implement and maintain the FRMS
- ensure compliance of the organization with the FRMS policy
PERSON/COMMITTEE RESPONSIBLE FOR THE FRMS

The responsibilities of the person and/or committee responsible for the FRMS are to:

- report directly to the manager responsible.
- liaise with appropriate local safety committees within the organization to ensure consistency with other safety policies and procedures.
- design/tailor and implement an appropriate FRMS to identify, assess, and manage the risks associated with fatigue. This should be developed in conjunction with employees and their representatives (e.g., unions). This FRMS shall be reviewed on a regular basis to reflect changes in work and improvements in methods of fatigue management. The person and/or committee responsible for the FRMS shall also ensure that there is an appropriate reporting process and a designated person accountable for each area of operation. The designated person(s) will report to the person responsible for the FRMS as appropriate.
- ensure that all employees and contractors for whom fatigue is a potential safety hazard successfully complete a competency-based training program that enables them to:
  - identify the risks associated with fatigue
  - identify and implement appropriate strategies for minimizing fatigue-related risk
  - determine whether their behaviour is consistent with appropriate fatigue management plans
- develop an appropriate management system for:
  - quantifying and reporting the risks associated with work practices
  - determining the extent to which fatigue may contribute to accidents and human errors in the workplace
  - determining compliance with the FRMS
- review, monitor, and improve fatigue risk management practices in response to information obtained through feedback processes.
**EMPLOYEES**

Employees are responsible for minimizing the risks associated with non-work sources of fatigue. All employees are responsible for:

- ensuring they understand and fulfill their responsibilities with respect to appropriate sections of the FRMS
- ensuring they successfully complete all relevant training
- using their training to identify, report, and manage any actual or potential risks linked to fatigue
- using their scheduled time away from work to obtain an amount of sleep sufficient to minimize the risks of fatigue-related accidents and injuries. The definition of sufficient sleep is given in section 3.4.
- informing the appropriate individual if they have not obtained sufficient sleep. Appropriate individuals are identified in the fatigue risk management plan (section 3.7).
3.1 Preface (Mandatory)

An effective fatigue risk management plan should take a systems approach to minimizing fatigue-related incidents. The FRMS section of this policy tool is based on the five-level error trajectory (see Developing and Implementing a Fatigue Risk Management System (TP 14575E) for more detailed discussion). At Level 1, organizations must provide sufficient sleep opportunity to all employees. This can be achieved either through prescriptive hours of service rules or computer-based fatigue modelling (see Section 3.3). At Level 2, organizations should encourage employees so that, when provided with sufficient sleep opportunity, they...
Fatigue Risk Management System for the Canadian Aviation Industry

An FRMS should be part of your wider SMS as an integrated set of work practices and procedures for monitoring and improving the safety of all aspects of your organization. It recognizes the potential for fatigue-related errors and establishes robust defences to minimize the likelihood of incidents or accidents.

As with all safety management systems, fatigue risk management involves goal setting, planning, documentation, and measuring performance against goals. An FRMS should be a comprehensive, integrated tool for managing fatigue in operational settings.

This section should include general information about the FRMS and provide a framework for the remainder of the manual. It should say why the FRMS has been implemented and list the basic components that it covers.

**Points to Consider**

- What is the basic structure of the FRMS?
3.2 FRMS Policy

3.2.1 Senior Management
Commitment to Managing
Fatigue (Mandatory)

Every organization is unique in terms of the size of its operation, layout of its facilities, frequency of aircraft movements, and maintenance and flight operations. The FRMS you develop needs to be tailored to meet the needs of your specific operation.

This section must contain a clear commitment to the FRMS from the organization’s
senior management. This is an overall statement about the management of fatigue hazard (see Developing and Implementing a Fatigue Risk Management System (TP 14575E) for an example of such a mission statement). The statement outlines the corporate philosophy of fatigue risk management and clearly identifies the person(s) responsible for oversight of the FRMS within the company. FRMS policies and procedures must be communicated to all employees with a clear endorsement by senior management.

Your policy statement should clearly state:

- commitment of senior management to the FRMS
- responsibilities and accountability of the accountable executive, managers, committees, and employees

- how the organization will achieve its safety objectives
- resources allocated
- fatigue-related safety outcomes expected of managers, employees, and contractors

You should also include a statement explaining how the FRMS interacts with your SMS.

Points to Consider

- Has senior management given support and commitment to FRMS implementation?
- What is the overall purpose of the FRMS?
- What resources are allocated for the FRMS?

SAMPLE TEXT

Section 3.2.1 Senior Management Commitment to Managing Fatigue (Mandatory)

1. [Insert Company Name]’s Fatigue Risk Management System policy represents the strongest commitment at the highest level — signed by the accountable executive.

[insert Company Name] is committed to protecting all employees, contractors, service providers, clients, visitors, and the general public from fatigue-related risk. There will be no compromise in an employee’s well-being in anything we do. Implementing measures to minimize fatigue-related risk and create a safe, healthy, and injury-free environment is a leadership responsibility. Continuing support of this effort is the responsibility of everyone.
2. The purpose of the FRMS is to reduce, as far as practicably reasonable, workplace fatigue and its risks, to ensure a safe and error-free work environment for employees, contractors, and clients. The objectives of this policy are to ensure:

- Employees are fit for work
- The company enjoys a safe working environment by minimizing hazards associated with fatigue
- The fatigue hazards associated with long work hours and shift work are minimized
- Employees have access to assistance through a range of preventative initiatives, including training
- Informed decisions are made about work design
- On-going risk assessment and hazard monitoring takes place
- Employees unfit for duty as a result of fatigue will be dealt with consistently and fairly in accordance with this policy

Resources for maintenance, development and implementation, updating and reporting of fatigue in the workplace in relation to the FRMS policy and personnel responsible for it will be through the Human Resources Department (or similar).

3.2.2 Fatigue-related Safety Objectives (Mandatory)

Fatigue-related safety objectives form the basis for measuring the success of the FRMS components. Safety objectives need to be specific, measurable, realistic, and have the backing of those who have to deliver them. Both short- and long-term objectives should be set and prioritized, and balanced with business requirements.

Fatigue risk management objectives are outcome-based to meet the organization’s safety policies. They should be transparent to employees and customers and clearly outline expectations and intent to ensure a safe work environment for everyone.

It is essential that employees know how these objectives affect their job functions and roles. Simply informing employees that they need to manage fatigue-related risk is not sufficient. They should be given operational roles or responsibilities that ensure fatigue-related risk is managed appropriately.

Points to Consider

- What does the organization aim to achieve with FRMS implementation? (This may extend beyond the reduction of fatigue-related risk to aspects such as increased employee morale or increased performance capacity)
- How does the organization plan to achieve that?
Section 3.2.2  Fatigue-related Safety Objectives (Mandatory)

All levels of management are committed to managing the risk of workplace fatigue. This company has clear employee safety standards with clear accountability, as outlined in Section 2.3.

We involve everyone in the process, as described in Section 3.2.

We provide the necessary training to build and maintain meaningful fatigue-risk management safety leadership skills, as stated in Section 4.

3.2.3 Communication and Consultation (Mandatory)

As with the wider SMS, information on FRMS policies, objectives, and responsibilities must be clearly communicated to staff, consultants, customers, and other appropriate individuals.

Where possible, the communication process should be recorded and filed for future reference by management and/or a Transport Canada audit team. Methods of communication could include memos, e-mail, or posters. Employees may be invited to submit agenda items to the FRMS Committee.

Whatever the method, communication needs to be clear and unambiguous, specific, and easily transferred and recorded by some means. An important step in this communication process is feedback.

Feedback can be formal and informal. Formal communication may take the form of minutes from the FRMS committee meetings or newsletters. Informal communication may be verbal. For example, a supervisor may update employees on the outcome of a fatigue-related issue during a lunch break.

In this section, you need to describe how you will distribute FRMS-related information, throughout the organization. What method will you use? How is the information to be distributed? Who is responsible? What is the time frame?

You also need to describe the methods of communication between the person/committee responsible for the FRMS and senior management. For example, regular, scheduled meetings with a set agenda or e-mail updates following each FRMS committee meeting.

This section should also detail the level of consultation with levels of management and employees during the FRMS design and review process. All employees should have the opportunity to participate in the FRMS design and review. There are many ways of achieving this. For example,
groups, one-on-one interviews, questionnaires, or employees may be asked to e-mail feedback.

Finally, you need to describe how you will distribute non-critical information related to fatigue. This might include educational information related to personal fatigue-risk management strategies. Examples might include memos, website, company newsletter, and safety notice boards.

**Points to Consider**

- How will information related to the FRMS be distributed and recorded?
- Who needs to receive FRMS related information?
- What level of consultation will be conducted among employees during the FRMS design and review process?
- Who will be involved in the FRMS consultation process?
- How will the FRMS consultation process be conducted?

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**SAMPLE TEXT**

**Section 3.2.3 Communication and Consultation (Mandatory)**

1. The person/committee responsible for the FRMS will distribute information about the FRMS and informing all employees of their individual responsibilities. The preferred method of delivery for critical safety-related information at this organization is through safety meetings, followed up by e-mailed meeting minutes.

   All employees will be consulted during the FRMS design and review processes. Employees will be given a training session on fatigue-risk management and FRMS components (see Section 4). Each training session will be followed by a focus group, during which employees will be able to provide feedback on the framework of the FRMS. Feedback provided through the focus groups will form the basis of any changes to the FRMS during the review process.

2. Whenever there is an urgent need to distribute fatigue-related safety information or to take safety-related action, employees will be notified directly by their supervisors. An update on FRMS activities will be published and e-mailed to all staff twice a year.

   Employees will be consulted during any review of the FRMS. Employees will receive a copy of the FRMS along with a questionnaire to be returned to the person responsible for the FRMS. Feedback provided through the questionnaire will be considered during the annual FRMS review process.
3.3 Hours of Service and Scheduling (Mandatory)

The degree of work-related fatigue associated with a given task on a given schedule is linked to the degree a schedule precludes sleep of sufficient quality and duration to ensure employees are fit for work. A schedule produces higher levels of work-related fatigue if it requires an employee to work more often at times when one is socially and biologically predisposed to sleeping.

It is important that schedules provide employees with sufficient sleep opportunity to ensure they are fit for work. The factors that affect sleep opportunity are the length and timing of shifts, time away from work, long blocks of shifts, and biological limits on recovery.

There are a number of ways to ensure employees have been provided with sufficient sleep opportunity within a schedule:

- operate within federal or provincial hours-of-work rules
- use a computer-based fatigue modelling package
- use a fatigue likelihood scoring matrix

Biomathematical modelling

Many models predict fatigue based on planned or actual hours of work. They consider a number of factors including the timing and duration of all shifts in the previous days (with more weight given to more recent shifts). Most models also allow comparison of various schedules and the fatigue “scores” that each may produce in an employee population.

Using a “fatigue score” as an index of average sleep opportunity, organizations can determine whether sleep opportunity is adequate by comparing the estimated fatigue score to a threshold value established by the organization in advance. Schedules that produce a score over this threshold value may be considered to provide inadequate sleep opportunity. Any organization that chooses to use a biomathematical model should set threshold values for fatigue scores based on a risk assessment of the tasks found in the workplace. The risk assessment process may identify different task categories that require different threshold values based on their susceptibility to fatigue impairment. These threshold values are used to establish compliance tables for the schedules of various workgroups. To keep compliance tables convenient to manage, task categorization should be broad and based on criticality and susceptibility to fatigue risks.

The most effective way to use biomathematical models for scheduling is to set risk-based limits and restrict how much of the schedule exceeds them. Using this approach, the company defines acceptable, questionable, and unacceptable zones. Fatigue (sleep opportunity) scores (based on a task-defined risk assessment) are assigned to the acceptable/questionable and questionable/unacceptable thresholds.

Organizations should not intentionally schedule work with scores in the unacceptable zone and 95% of actual work hours must fall within the acceptable zone. A small percentage of total hours are permitted for scheduled work in the
questionable zone. Circumstances may sometimes dictate that actual hours worked fall in the unacceptable zone. All work in zones other than acceptable must be investigated and appropriate corrective action taken. An example of a compliance table that shows threshold values, percentages of planned and actual hours of work, and corrective actions is shown below.

Create a compliance table or a list of threshold values as needed for each task category defined in the risk assessment process. The FRMS manual could also contain a list of corrective actions to be taken when necessary.

### Example of a compliance table used with biomathematical modelling

<table>
<thead>
<tr>
<th>Threshold values</th>
<th>Planned hours of work</th>
<th>Actual hours of work</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>&lt; X</td>
<td>97%</td>
<td>95%</td>
</tr>
<tr>
<td>Questionable</td>
<td>[X-Y]</td>
<td>2.5%</td>
<td>3.75%</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>&gt; Y</td>
<td>0%</td>
<td>1.25%</td>
</tr>
</tbody>
</table>

### Fatigue Likelihood Scoring Matrix for Work Schedules

An alternative assessment tool to the biomathematical model is a fatigue likelihood scoring matrix. There are five key elements that make up this matrix:

1. The total number of hours worked in a seven-day period. As total hours worked increases, sleep opportunity decreases.

2. The maximum length of an individual shift. As the length of a given shift increases, the subsequent sleep opportunity decreases.

3. The minimum length of a short break. A short break is defined as a single sleep opportunity between work periods. It is typically a period shorter than 32 hours. As the break between shifts decreases, so does the sleep opportunity.
4. The total number of hours worked between 9 p.m. and 9 a.m. in a seven-day period. This element captures late finishes, early starts, and night work. All of these will reduce the night sleep opportunity and result in a significant reduction in total sleep opportunity.

5. The frequency of long breaks. A long break is defined as a period of two night sleeps with a non-working day in between. Long breaks typically provide a significant opportunity to recover from sleep loss accumulated over a sequence of work periods.

A schedule can then be scored on each of the five elements using the following table.

<table>
<thead>
<tr>
<th>Fatigue Likelihood Scoring Matrix for Work Schedules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>a) Total hours per 7 days</td>
</tr>
<tr>
<td>&lt; 36 hours</td>
</tr>
<tr>
<td>b) Maximum shift duration</td>
</tr>
<tr>
<td>&lt; 8 hours</td>
</tr>
<tr>
<td>c) Minimum short break duration</td>
</tr>
<tr>
<td>&gt; 16 hours</td>
</tr>
<tr>
<td>d) Maximum night work per 7 days</td>
</tr>
<tr>
<td>0 hours</td>
</tr>
<tr>
<td>e) Long break frequency</td>
</tr>
<tr>
<td>&lt; 1 in 7 days</td>
</tr>
</tbody>
</table>

The points for each element can then be added to provide a score between 0 and 40 that indicates the degree of sleep opportunity afforded by the schedule. Schedules with a lower score provide greater sleep opportunity (and are less likely to be associated with work-related fatigue) than those with a higher score. Organizations must define what they deem to be acceptable or unacceptable. The cut-off point for an acceptable schedule is determined by the specific characteristics of the organization. For example, an organization could choose to assign a lower cut-off score for highly complex or safety-critical work, or a high physical stress work environment (e.g. high humidity), than less complex or safe-
ty-critical work in an air-conditioned environment.

Organizations should consider consulting with employees, the regulator, researchers, and others in the industry to establish some initial standards for how sleep opportunity can be assessed using each of these approaches and appropriate threshold values for adequate sleep opportunity for various categories of employees in the Canadian aviation industry.

Points to Consider

- How likely are employees to be fatigued due to lack of sleep opportunity in their work schedule (night work, early morning starts, extended shifts, overtime, long blocks of shifts, amount of time away from work, commute time, etc.)?
- How will the work schedules be assessed for fatigue-related risk?
- What is the level of fatigue-related risk associated with work tasks within the organization?
- What benchmark is the organization using to define fatigue-related risk as acceptable, questionable, or unacceptable?
- What procedures are in place for when work schedules fall within the questionable zone?

SAMPLE TEXT

Section 3.3  Hours of Service and Scheduling (Mandatory)

Work schedules will be assessed for adequate sleep opportunity and considered appropriate according to the following compliance table. Planned work hours will be assessed in advance, whereas actual work hours shall be assessed retrospectively.

Through the planning phase, work schedules will be assessed using a Fatigue Audit InterDyne (FAID) software assessment tool to determine whether employees have been provided with adequate average sleep opportunity. Fatigue-related risk will be managed using a risk control process. Management will undertake a fatigue-related risk assessment for specific work groups and tasks. These will be assigned a nominal upper limit consistent with a safe system of work.
The compliance table below for [insert task category designator] shows the FAID threshold values for providing sufficient sleep opportunity. The upper threshold sets the limit for an acceptable degree of sleep opportunity provided by a work schedule for the designated group of employees. FAID scores above [insert upper threshold value] are considered to be in the unacceptable zone. The lower threshold is set at [insert lower threshold value — for FAID this is typically 10-20 points below upper threshold]. FAID scores falling between the upper and lower thresholds are in the questionable zone, and scores below the lower threshold are in the acceptable zone. Compliance is determined by calculating the percentage of total hours worked above the two designated thresholds.

**Compliance table for [insert task category designator]**

<table>
<thead>
<tr>
<th>FAID threshold values</th>
<th>Planned hours of work</th>
<th>Actual hours of work</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceptable</strong></td>
<td>&lt; X</td>
<td>No less than 97.5% of scheduled hours</td>
<td>None unless evidence of Level 2 hazards or higher are present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No less than 95% of hours worked</td>
<td></td>
</tr>
<tr>
<td><strong>Questionable</strong></td>
<td>[X-Y]</td>
<td>No greater than 2.5% of scheduled hours</td>
<td>Where there is reasonable likelihood of recurrence (more than twice in a row), investigate and undertake corrective action before next audit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No greater than 3.75% of hours worked</td>
<td></td>
</tr>
<tr>
<td><strong>Unacceptable</strong></td>
<td>&gt; Y</td>
<td>0% of scheduled hours</td>
<td>Investigate and undertake immediate corrective action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No greater than 1.25% of hours worked</td>
<td></td>
</tr>
</tbody>
</table>
whether an employee has obtained sufficient sleep and is, by inference, fit for work.

These thresholds are equivalent to the simple formula used by people to determine whether they are alcohol impaired. For example, in counting number of drinks they have had over a period of time. While counting sleep and time awake is not a perfect indicator of the level of fatigue for all individuals on all occasions, it can provide employees with a simple measure for determining the relative likelihood that they are fatigued.

Calculating an Individual Fatigue Likelihood Score (IFLS)

Most evidence suggests that to maintain optimum performance, health, and well-being, individuals should get between seven and nine hours sleep per 24-hour period.

Many studies have investigated how decreasing levels of sleep and increasing...
time awake affects performance (see references in Section 7). In general, research has found that performance begins to become impaired after less than five hours sleep over a 24-hour period. Performance also becomes impaired if sleep consistently falls below six hours per night on an ongoing basis (over the period of a week).

A measure of fitness-for-duty related to fatigue can be calculated using the following table.

As prior sleep decreases and time awake increases, the likelihood of fatigue-related symptoms, errors, and incidents also increases. In general, X should be greater than 5, Y should be greater than 12 and Z should be less than Y. Each of the factors (X, Y, and Z) are added to provide an overall score of individual fatigue likelihood. Employees who obtain an elevated score should inform the appropriate supervisor or manager, and appropriate action should be taken. It is useful to establish a decision tree for employees and managers that provides clear information about appropriate action at various levels of fatigue. The table below shows an example.

<table>
<thead>
<tr>
<th>Prior sleep/wake factor</th>
<th>Threshold value</th>
<th>Scoring*</th>
</tr>
</thead>
<tbody>
<tr>
<td>X (sleep in prior 24 hours)</td>
<td>5 hours</td>
<td>Add 4 points for every hour below threshold</td>
</tr>
<tr>
<td>Y (sleep in prior 48 hours)</td>
<td>12 hours</td>
<td>Add 2 points for each hour below threshold</td>
</tr>
<tr>
<td>Z (time awake since last sleep)</td>
<td>Y</td>
<td>Add 1 point for each hour of wakefulness greater than Y</td>
</tr>
</tbody>
</table>

* Partial hours should be pro-rated or scored proportionally. For example, if the scoring calls for 4 points for every hour below the threshold, give 2 points for a half-hour, or 1 point for 15 minutes.
### Decision tree based on Individual Fatigue Likelihood Score

<table>
<thead>
<tr>
<th>Individual Fatigue Score</th>
<th>Risk Level</th>
<th>Approved Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>Acceptable</td>
<td>No additional controls necessary except in the presence of higher level indicators of fatigue (i.e., symptoms, errors, or incidents).</td>
</tr>
<tr>
<td>[Zero-A]</td>
<td>Minor</td>
<td>Report fatigue to local supervisor. Implement approved individual controls including, but not limited to: symptom monitoring, strategic use of caffeine, task rotation, increased personal and co-worker monitoring.</td>
</tr>
<tr>
<td>[A-B]</td>
<td>Moderate</td>
<td>Report fatigue to local manager. Implement additional approved individual controls, including but not limited to: task reallocation, napping, increased level of supervisory monitoring.</td>
</tr>
<tr>
<td>&gt; B</td>
<td>Significant</td>
<td>File formal fatigue report. Do not engage in safety-critical tasks. Do not recommence work until sufficiently rested as per prior sleep/wake rules.</td>
</tr>
</tbody>
</table>

Scores that constitute A and B should be worked out on an industry, sector, or organizational basis. They should be based on overall job risk and consultation with employees.

**Potential Applications of the Individual Fatigue Likelihood Score (IFLS)**

One way to use the IFLS as a Level 2 control is to apply the minimum sleep and maximum time awake rules as a simple self-assessment tool embedded in the training program. Employees would determine their own risk of fatigue and be required to manage their own fatigue with countermeasures such as sleep planning, strategic napping, caffeine, breaks, task rotation, etc.

Or employees might be required to report actual sleep obtained on a daily basis to the employer and to engage in clearly defined and documented risk mitigation strategies. In this case, the organization should design specific decision trees for designated tasks or work groups indicating what should be done at specified IFLSs. Levels of risk mitigation should increase with higher IFLSs. Examples of fatigue control measures for the various levels of risk are presented below.
\textit{Minor increase in risk}: At this level, individual fatigue controls implemented by the employee are most common. Employees should report the level of fatigue-related risk to the appropriate supervisor according to the organizational reporting structure. The use of symptom checklists prior to starting work would be appropriate as would an increased level of supervision by the employee and/or by co-workers. Appropriate use of caffeine may be recommended, particularly during hours when an employee would typically be asleep. It would also be reasonable for the employee and/or co-workers to restructure work tasks and/or breaks to minimize any additional risk.

\textit{Moderate increase in risk}: No employee should begin work with an IFLS in this range without completing a symptom checklist and indicating in writing that they consider themselves fit to work. Supervisors should discuss the work assignment with the employee and ensure that the number of safety-critical tasks are minimized and that all reasonable efforts are made to reallocate the workload safely. Employees with an IFLS in this range would receive priority for napping, where possible. The use of caffeine or other strategies to stay awake (bright lights, exercise, cool air, noise or upbeat music, etc.) would be common.

\textit{Significant increase in risk}: An employee with an IFLS in this range would typically be considered unfit for work. This level of impairment is broadly comparable to drug or alcohol intoxication. It is unlikely that an employee would be permitted to undertake any safety-critical task and would probably not be allowed to drive to or from the workplace. Activities should not require employees to be responsible for the safety of themselves or others and should be limited to simple tasks in a relatively hazard-free environment. Before returning to work, all employees should be given adequate opportunity to obtain sufficient sleep. In general, employees should not be required to return until their fatigue likelihood score is zero.

When an employee notifies a supervisor or line manager of an elevated fatigue score, the reasons for the score need not to be discussed unless the employee reports such a score more than three times in 90 days. Discussions about the cause of multiple reports should typically involve the employee assistance program in the first instance (where applicable) and can subsequently involve line managers and supervisors where appropriate.

\textbf{Using the Individual Fatigue Likelihood Score (IFLS) to Improve Work Scheduling Practices}

Level 2 controls are designed to ensure adequate sleep at the individual level. They use relatively objective measures that are intuitively meaningful, observable, and easily recorded at the individual and group levels.

If an organization emphasizes Level 2 controls and they are reliably reported and documented, they can also be used to collect valuable data on fatigue in the organization. The data could be aggregated across an entire organization or even industry to provide the basis of a statistically sound approach to evaluating the
amount of sleep and time awake provided by a schedule and form the basis for evaluating the effectiveness of scheduling factors set out in Section 3.3.

**Points to Consider**

- What is the minimum amount of sleep required to be considered fit for work:
  - on a one-time basis?
  - on a continual basis?
  - for high-risk work?
  - for low-risk work?
- What are the measures or procedures to follow when an employee has not obtained sufficient sleep?
- What should be done when this happens repeatedly?
- What policies or procedures are in place for contractors working on site?

**Section 3.4 Verification of Actual Sleep** *(Mandatory)*

Prior to starting work, employees who have undergone fatigue management awareness training will be required to assess their fitness-for-work risk by calculating their individual fatigue likelihood score for the previous 48 hours. The result helps employees determine the likelihood of fatigue-related impairment and the degree of safety associated with scheduled work activities.

An individual fatigue likelihood score (IFLS) can be calculated using the following table.

**How to calculate the Individual Fatigue Likelihood Score**

<table>
<thead>
<tr>
<th>Prior sleep/wake factor</th>
<th>Threshold value</th>
<th>Scoring*</th>
</tr>
</thead>
<tbody>
<tr>
<td>X (sleep in prior 24 hours)</td>
<td>5 hours</td>
<td>Add 4 points for every hour below threshold</td>
</tr>
<tr>
<td>Y (sleep in prior 48 hours)</td>
<td>12 hours</td>
<td>Add 2 points for each hour below threshold</td>
</tr>
<tr>
<td>Z (time awake since last sleep)</td>
<td>Y</td>
<td>Add 1 point for each hour of wakefulness greater than Y</td>
</tr>
</tbody>
</table>

* Partial hours should be pro-rated or scored proportionally. For example, if the scoring calls for 4 points for every hour below the threshold, give 2 points for a half hour and 1 point for 15 minutes.
If the assessment finds an elevated level of fatigue-related risk, the employee should inform the appropriate line manager or supervisor as soon as practical. Together, the employee and manager should discuss and implement appropriate controls. Employees who report a non-zero score more than 3 times in 90 days will be referred to the employee assistance program to discuss potential reasons and solutions for the lack of sleep.

The following decision tree indicates proper course of action to follow, based on IFLS scores.

**Decision tree based on Individual Fatigue Likelihood Score**

<table>
<thead>
<tr>
<th>Individual Fatigue Score</th>
<th>Risk Level</th>
<th>Approved Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>Acceptable</td>
<td>No additional controls necessary except in the presence of higher level indicators of fatigue (i.e. symptoms, errors, or incidents).</td>
</tr>
<tr>
<td>1-4</td>
<td>Minor</td>
<td>Inform line supervisor and document in daily log-book. Self-monitor for fatigue-related symptoms, and apply individual controls such as strategic use of caffeine, task rotation, working in pairs, additional rest breaks.</td>
</tr>
<tr>
<td>5-8</td>
<td>Moderate</td>
<td>Inform local manager and document in a fatigue report. Implement additional fatigue controls such as task reallocation, napping, and increased level of peer and supervisory monitoring.</td>
</tr>
<tr>
<td>9+</td>
<td>Significant</td>
<td>Call manager before driving to work. Document in a fatigue report on next work shift. Do not engage in safety-critical tasks (including driving to work), and do not return to work until sufficiently rested as per sleep/time awake rules.</td>
</tr>
</tbody>
</table>
Each employee will be provided with a pocket card for easy reference.

**Individual Fatigue Likelihood**

**Step 1. Sleep in prior 24 hours**
- Sleep: <2h 3h 4h 5+h
- Points: 12 8 4 0

**Step 2. Sleep in prior 48 hours**
- Sleep: <8h 9h 10h 11h 12+h
- Points: 8 6 4 2 0

**Step 3. Hours awake since last sleep**
Add one point per hour awake greater than sleep in step 2.

**Step 4. Sleep in prior 24 hours**
Add all points together to determine your score

<table>
<thead>
<tr>
<th>Score</th>
<th>Control Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Self-monitoring</td>
</tr>
<tr>
<td>5-8</td>
<td>Supervisor monitoring</td>
</tr>
<tr>
<td>9+</td>
<td>Don’t start shift until fit for work</td>
</tr>
</tbody>
</table>

Refer to FRMS policy for detailed explanation of controls

*Untrained Employee/Contractor Assessment*

Employees and contractors who have not taken fatigue management training are asked to confirm that they have had a minimum of six hours sleep in the 24 hours prior to starting work.

Where employees have not had six hours of sleep, they are required to report this to an appropriate individual. A risk assessment must be conducted to determine the appropriate action. As a general rule, obtaining only five to six hours of sleep should be considered a minor hazard, obtaining four to five should be considered a moderate hazard, and obtaining less than four should be considered a significant hazard.

In general, managers and supervisors should use controls similar to those outlined in the decision tree. This may include but is not limited to: task rotation, napping, workload reallocation, sending the employee home, provision of transport off site, and/or requiring the employee get adequate sleep prior to returning to work.
3.5 Fatigue-related Symptoms (Mandatory)

Level 3 controls are concerned with reducing the likelihood that employees exhibit fatigue-related symptoms – and reducing the consequences. There are many reasons that an employee may appear to be or act fatigued. If the FRMS is operating effectively, the main cause – insufficient sleep – should be screened out by Level 1 or 2 controls.

The type of work performed may be particularly physically or mentally demanding, which can exacerbate fatigue and lead to fatigue-related symptoms. External factors such as weather can also affect fatigue. These factors should all be considered in the risk assessment of work tasks so that scheduling parameters can be set for different work groups or work tasks where warranted. The appearance of fatigue-related symptoms during certain work periods or tasks can be an indication that risk profiles need to be reassessed.

There may be situations where fatigue-related symptoms are not directly linked to work tasks or environmental conditions, and where the employee has been provided sufficient opportunity and actually obtained sufficient sleep. Non-work factors are likely the cause. For example, the employee may be experiencing personal stress (e.g., sickness, newborn baby, financial issues, divorce) that is disturbing sleep.

Employees who say they get enough sleep and cannot explain their fatigue-related symptoms should undergo screening for a sleep disorder. Some of the more common sleep disorders are discussed in Developing and Implementing a Fatigue Risk Management System (TP 14575E). Employee suspected of having a sleep disorder should be referred to a doctor or sleep specialist as soon as possible, particularly if they are performing high-risk tasks.

Level 3 controls – observing and reporting fatigue-related symptoms – are important in an effective FRMS to determine whether:

- minimum sleep requirements are appropriate
- task-scheduling processes are appropriate
- non-work activities are affecting the risk of workplace fatigue
- employees have a sleep disorder

The following table lists typical symptoms of fatigue. If employees have experienced more than three of the specified symptoms in a 15-minute-period, they are likely to be fatigued and should be considered at an elevated level of fatigue-related risk.
In addition to general symptoms of fatigue, most employees are also aware of task-specific indicators of fatigue. These should be identified during the task assessment and included in the table of reportable symptoms. Actions to be taken when fatigue-related symptoms are observed and reported should be determined in a similar fashion to Level 1 and 2 controls.

When employees notice symptoms of fatigue in a co-worker, they should point it out to the co-worker. If the situation arises again, employees should encourage the co-worker to report the fatigue and take the precautions outlined in the FRMS manual.

Employees repeatedly exhibiting fatigue-related symptoms should be encouraged to consult medical specialist to determine whether they suffer from a sleep disorder. This is particularly important for employees with a body mass index greater than 30 kg/m² and a neck size greater than 16 inches (40 cm) since they are at a greater risk for sleep apnea.

Some organizations are exploring performance testing technologies that could theoretically provide a more objective indication of fatigue-related impairment. Some of the main technologies currently available include the Occupational Safety Performance Assessment Test (OSPAT), psychomotor vigilance tests (PVT), Digit-Symbol Substitution Tests (DSST), pupilometry and blink tests. While some of these technologies are promising, they have not yet been shown to be sufficiently scientifically reliable to serve as a sole means to detect fatigue-related impairment.

### Symptoms of fatigue

<table>
<thead>
<tr>
<th>Physical Symptoms</th>
<th>Mental Symptoms</th>
<th>Emotional Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yawning</td>
<td>• Difficulty concentrating on the current work task</td>
<td>• More quiet or withdrawn than normal</td>
</tr>
<tr>
<td>• Heavy eyelids</td>
<td>• Lapses in attention</td>
<td>• Lethargic or lacking in energy</td>
</tr>
<tr>
<td>• Eye-rubbing</td>
<td>• Difficulty remembering what you are meant to be doing</td>
<td>• Lacking in motivation to do the task well</td>
</tr>
<tr>
<td>• Head drooping</td>
<td>• Failure to communicate important information to a colleague</td>
<td>• Irritable or bad tempered with colleagues, family, or friends</td>
</tr>
<tr>
<td>• Inappropriate or unintentional dozing</td>
<td>• Failure to anticipate events or actions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unintentionally doing the wrong thing (errors of commission)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unintentionally failing to do the right thing (errors of omission)</td>
<td></td>
</tr>
</tbody>
</table>
Using Symptom Data to Assess Level 1 and 2 Controls

Documenting Level 3 controls can help double-check that Level 1 and 2 controls are appropriate. For example, if there is a high incidence of fatigue-related symptoms, and employees say they are complying with the organization’s minimum sleep requirements, the scoring system for sufficient sleep may need to be reviewed.

Fatigue-related symptoms can also flag employees who breach their responsibility of obtaining appropriate sleep in the time provided. For example, it is unlikely that employees who choose to engage in social activities rather than sleep will report their inadequate sleep to management. If employees regularly demonstrate fatigue-related symptoms, they may need to be reminded of their responsibility under the FRMS to arrive at work fit for duty.

Level 3 controls can also flag employees who experience disturbed sleep quality or quantity beyond their or their employer’s control, and who may be impaired by fatigue.

Points to Consider

- What are the main fatigue-related symptoms experienced by employees in the work environment?
- What symptoms are particularly indicative of being unfit for duty due to fatigue?
- How should fatigue-related symptoms be reported/used within the overall FRMS?
Section 3.5  Fatigue-related Symptoms (Mandatory)

[Insert company name] recognizes that a result of zero on the IFLS is not a guarantee that an employee is fit for work with respect to fatigue. Personal (stress, medical condition, etc.) and work-related factors (weather, time pressures, etc.) may contribute to the level of fatigue. Employees and supervisors are expected to be proactive in observing and acting on fatigue-related symptoms in one another. Typical symptoms of fatigue are listed in the table below. If a symptom of fatigue is observed in another person, it should be brought to that person’s attention. As a guideline, if an employee experiences more than three of the specified symptoms in a 15-minute period they are likely to be fatigued and should be considered to be at an elevated level of fatigue-related risk. Appropriate fatigue control measures need to be applied. Employees that repeatedly exhibit fatigue-related symptoms over a number of shifts will be referred to the employee assistance program, screened for sleep disorders, and may be provided further consultation with a doctor and/or sleep specialist. Reporting protocols are outlined later in this document.

### Symptoms of Fatigue

<table>
<thead>
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</tr>
</tbody>
</table>
3.6 Fatigue-Proofing Strategies
(Recommended)

The main benefit of an FRMS is to provide organizations and employees with an increased level of safety management. The scheduling guidelines set out in Section 3.3 should be used for the majority of the company’s operations. However, there will be occasions when operational demands require extended hours of work. This may result in employees working through higher levels of fatigue than normal.

In these situations, there are a number of strategies that can be used to reduce the consequences of increased fatigue. For example, management may rely more heavily on Level 2 and 3 controls. This can help to determine which employees are most appropriate to complete the additional duties. To prevent fatigue-related errors, management should use Level 4 strategies, such as:

- napping
- supervisor and co-worker monitoring
- double-check systems
- task rotation and reallocation
- additional breaks and strategic use of caffeine

The organization should provide guidelines on how each of these can be used.

**Napping:** As a general rule, those with the highest risk should have the highest priority for napping. In general, the longer the nap the greater the recovery value. Naps should last at least 20 minutes and no more than two hours to be of maximum benefit. Shorter naps do not produce appreciable or lasting improvements in alertness. Sleeping more than two hours brings little additional benefit, particularly when that time could be used to provide another employee with a napping opportunity. Where controlled napping is allowed, the company should detail the circumstances under which it is permitted.

It is important to keep in mind that longer naps are associated with a longer period of sleepiness immediately following waking. This effect is known as sleep inertia. Employees should be given sufficient time to overcome the effects of sleep inertia before returning to work. Typically, this is at least 10 minutes during the day, and up to 20 minutes in the early hours of the morning.

**Monitoring and double-check systems:** Where an employee is at an elevated risk of fatigue-related error, increased monitoring by peers or supervisors for fatigue-related symptoms and/or impaired task performance can be an effective strategy. However, this can be a sensitive issue and it is important that the criteria for increased monitoring are clear in advance to minimize misunderstanding.

Increased monitoring can be achieved in a number of ways. It can be as simple and informal as more frequent or regular conversations with the employee over the course of the shift. Or it can involve more formal policies or procedures that call for additional, verified supervisory checks on safety-critical work by the fatigued impaired employee, co-workers, or a supervisor/line manager.
Task rotation and reallocation: Monotonous tasks with little variety are particularly susceptible to the effects of fatigue. In many cases, the workload can be made more engaging by varying the tasks during a shift. It is important to understand that the benefits of task rotation do not increase linearly. In general, the number of different tasks undertaken in a given shift should not exceed three or four, or the risk of error due to unfamiliarity with the job at hand may rise. Where task rotation forms part of the control system for fatigue-related risk, the number and types of tasks allocated should be determined in consultation with employees.

When an employee shows signs of fatigue, or when a self-assessment tool indicates impairment from fatigue is likely, the employer should make sure that the employee is not given certain tasks that may be high-risk to the employee, colleagues, the work flow, and/or the general public. Acceptable activities might include simple procedural tasks, word or data processing, quality checks, and basic communication. This reduces the risk of an incident, but does not mitigate the employee’s fatigue.

Additional breaks and strategic use of caffeine: When operational requirements call for longer hours of work, additional breaks should be provided to employees when fatigue may impair their performance. A break of 10 to 20 minutes may permit improvements in performance on a short-term basis. Employees assigned to tasks that require sustained attention over prolonged periods of time should take a break at least every two hours. Research shows that performance starts deteriorating after two hours on high-demand tasks. The breaks should be used to engage in strategies to improve alertness, e.g., walk outside to get some fresh air, exercise, have a coffee, etc.

Caffeine can provide a short-term improvement in alertness when it is used strategically. A typical dose of caffeine (75 to 150 mg) will provide an increase in alertness approximately 20 minutes after ingestion. The stimulating effects will vary in intensity and duration (up to four hours) depending on how often and how much caffeine the body is used to. However, the body can develop a tolerance, meaning the more caffeine the body gets on a daily basis, the less noticeable are the stimulating effects.

The best way to think about caffeine is that it has the capacity to “shift” fatigue and alertness to more appropriate times. However, there are significant disadvantages to prolonged regular caffeine use. Individuals differ enormously in their sensitivity to both the positive and negative effects of caffeine.

Points to Consider

- What strategies will be employed to avoid fatigue-related errors when employees need to work through high levels of fatigue?
Section 3.6 Fatigue-Proofing Strategies (Recommended)

There may be occasions when operational demands require employees to work longer hours than normal. A number of control factors will be put in place. First, employees required to work additional work hours will be asked whether they have obtained six hours sleep in the last 24 hours. If they have not, fitness for duty will be considered using the protocol outlined in Section 3.4. In addition, employees will be required to complete a symptom checklist (see Section 3.5) every two hours. If an employee reports more than three symptoms, their fitness for duty should be examined by a supervisor. If at any stage an employee feels unfit for work, they will be relieved of duty and sent home or given an opportunity to rest.

A number of controls or strategies can be used to minimize the likelihood of errors when employees experience low or moderate levels of fatigue. These include:

- napping
- supervisor and co-worker monitoring
- task rotation and re-allocation
- additional breaks and strategic use of caffeine

Napping

Where appropriate, employees may be allowed to take a nap or controlled rest. [Insert company name] has provided a limited number of short-term sleeping facilities for employees during working hours.

Highest priority for napping will be given to those with the highest fatigue-related risk. Naps shall be at least 20 minutes and no more than 2 hours, depending on operational constraints and fatigue risk involved. Before returning to work after a nap, employees will be given sufficient time to overcome the effects of sleep inertia. Typically, this is at least 10 minutes during the day, and up to 20 minutes in the early hours of the morning.

Supervisory and co-worker monitoring

In instances where operational demands require extended hours of work that may result in employees working through higher levels of fatigue than normal, employees and supervisors will be proactive in observing and acting on fatigue-related symptoms in one another. In cases where fatigue symptoms are repeatedly observed in an employee, the supervisor shall be informed and measures will be taken to allow the employee to take a break or a nap, or use other strategies to improve alertness (such as exercise, caffeine). Additional supervisory checks for safety-critical work will also take place.
Task rotation and task re-allocation
Rotation of tasks will be arranged during periods when operational demands may increase fatigue-related risks. Monotonous tasks with little variety will be targeted in particular. Supervisors will rotate work in consultation with concerned employees to ensure that all are assigned to familiar tasks. No employee shall be assigned to more than three different tasks during a given period.

In situations of increased fatigue-related risk, such as when an employee repeatedly exhibits symptoms of fatigue, it may be necessary to re-schedule or re-assign some tasks. Any task sensitive to the effects of fatigue should be re-scheduled or re-assigned. The list of risk factors below should be used as a guideline to identify activities that need to be rescheduled or re-assigned:

[List risk factors specific to the company.]

Additional breaks and strategic use of caffeine
When operational requirements call for longer hours of work, additional breaks of 10 to 20 minutes will be provided to employees on request. Employees are responsible for monitoring themselves and for requesting a break when they feel it necessary to restore their performance levels. Employees should also suggest breaks to co-workers if they observe fatigue symptoms. During these breaks, employees will take necessary actions to counter fatigue effects (exercise, drink caffeine, etc.).

It should be noted that since habitual use diminishes the stimulating effects of caffeine, [insert company name] does not promote regular use of caffeine. However, it can be useful in contingency situations to help increase alertness when required.
3.7 Reporting Protocols
(Mandatory)

Reporting protocols within the FRMS should be defined on two levels:

1. Reporting fatigue-related risk (insufficient sleep or sleep opportunity, fatigue-related symptoms)
2. Reporting errors and incidents that are fatigue related

Reporting fatigue-related risk (recommended)

Reporting risk is important for FRMS review and evaluation. Collect data on the frequency that employees are at risk of fatigue-related error or incident. How often did the work schedule provide insufficient sleep opportunity? How often did employees report getting insufficient sleep? How often did they report experiencing fatigue-related symptoms?

Employees may be reluctant to report this level of fatigue-related impairment on formal incident reporting forms, particularly in the early stages of FRMS implementation. The company should ensure that employees are aware of the fatigue reporting policy and that reports submitted to the system remain confidential. A special reporting form may be appropriate. The company could set up a reporting system and fatigue occurrence database on the company intranet to collect information such as:

- What schedule have you been working for the last week?
- How much sleep did you obtain in the last 24 hours?
- How much sleep did you obtain in the last 48 hours?
- What fatigue-related symptoms have you been experiencing?
- Have you notified a supervisor that you are at risk of making a fatigue-related error?
- Who have you notified that you are at risk of making a fatigue-related error?
- What countermeasures have you used?

Reporting fatigue-related errors and incidents (mandatory)

Most organizations have formal requirements to report errors and incidents as a part of their SMS. Few, however, systematically examine whether fatigue was a contributing factor. Industries that rely on shift work should develop standard reporting criteria that accurately reflect the occurrence of fatigue and sleepiness-related errors and incidents.

For an error or incident to be defined as fatigue related, it must have:

1. occurred in the presence of fatigue and
2. been consistent with fatigue-related error (e.g., caused by employee falling asleep, inattention, delayed reaction time, complacency, etc.)

In order to define an event as fatigue related, the first three levels of control (see the figure in Section 3.1) must be reviewed:

1. Did the work schedule provide sufficient sleep opportunity for the employee?
2. Did the employee actually obtain sufficient sleep?
3. Was the event preceded by the presence of fatigue-related symptoms?

Examining planned and actual hours of work not only reveals whether changes led to insufficient sleep opportunity but can help the company better understand whether additional work hours were foreseeable and how to better allocate them in the future. Questions about the schedule could also include examining the commute to and from work for employees involved since this can also influence the sleep opportunity.

The second question allows the company to collect information on actual sleep obtained by the specific employee. How many hours of sleep did the employee obtain in the 24 and 48 hours before the event? How long was it since the employee had woken up from a sleep or a nap? If the employee had not obtained sufficient sleep, why not? Why was it not reported on arrival at work?

Since the reporting process relies heavily on the honesty of employees, it should be non-punitive. Incidents of insufficient sleep should be considered a learning experience for the organization and other employees, rather than as an incident that can affect an employee’s employment status.

The organization should also investigate whether the employee had been observed falling asleep or struggling to remain alert in the week before the event. This information could be collected either directly from the employee, or from co-workers or supervisors. Similarly, was the employee exhibiting any other fatigue-related symptoms directly before the event?

Additional questions that could be asked include:

- Did the employee take medications or drugs in the week prior to the event?
- Has the employee been diagnosed with or show symptoms of a medical problem or sleep disorder that may affect fatigue or alertness?
- Did the employee work at another job or have additional responsibilities during the two weeks before the event?

Assessing the information collected with these questions can provide organizations with a clearer understanding of when fatigue is a contributing factor to an error or incident.

Reporting non-critical errors also offers an opportunity to analyse the effectiveness of the FRMS. In any organization, there is a greater frequency of errors than incidents. An organization can determine the root causes of any fatigue-related risk and implement appropriate control strategies before an error becomes an incident.

Points to Consider

- What reporting structures are already in place within the organization?
- What is the process for reporting potential risk from fatigue (as opposed to an actual event)?
• What factors are to be investigated to determine whether fatigue was a contributing factor to an incident?

• How can fatigue be better reported within the organization?

**SAMPLE TEXT**

### Section 3.7 Reporting Protocols (Mandatory)

[Insert company name] is committed to continually reducing the risk of fatigue. To achieve this, a structured data collection process records when:

- An employee is at risk of making a fatigue-related error (i.e., provided with insufficient sleep opportunity within the schedule, actually obtained insufficient sleep, and/or exhibits fatigue-related symptoms)
- Fatigue has been a contributing factor to a safety-related error and/or incident

Employees are required to report all cases of fatigue-related risk, errors, and incidents to their immediate supervisor. The supervisor will act accordingly, depending on the severity of the case. This may include (but is not limited to) advising the employee to self-monitor performance, allocating peer/management supervision to the employee, task reassignment, scheduling naps, or sending the employee home.

A confidential reporting database (Fatigue Occurrences) has been made available to all employees on the company intranet. The purpose of this database is to collect information on the frequency that employees: are provided with insufficient sleep opportunity (due to overtime or contingency situations); obtain insufficient sleep; exhibit fatigue-related symptoms; or make a non-consequence error that may have been fatigue-related. Although employees are required to provide their name, this will only be used by the safety manager if more information is required. The intent is purely data collection, and the information will not be used for disciplinary purposes.

All reports of errors and incidents will be made using the existing SMS reporting framework (refer to SMS policy document). During the error/incident investigation process, the investigator will ask any employees involved to provide an accurate account of hours worked during the two weeks prior to the event, how much sleep was obtained during the preceding 24 and 48 hours, and whether they were experiencing any fatigue-related symptoms. Colleagues and supervisors will also be asked whether they observed any fatigue-related symptoms in the employees involved.

In consultation with management and safety officials, the investigator will recommend short term corrective actions for preventing similar events, and factors to consider in the FMRS review process.
All staff should be trained to understand the purpose of the FRMS and their responsibilities within the system. The person responsible for the FRMS or the FRMS Committee should arrange fatigue-related safety training for all employees. The training program should highlight the risk of fatigue, how it will be managed within the organization’s operations, and how it fits within existing organizational policies and procedures. It is essential that records be kept that include dates, names, subjects covered, and course presenters. The company may seek the assistance of fatigue specialists in the development of a training program.

Training tools developed by Transport Canada include:

- an introductory booklet (TP 14572E)
- a workbook for employees on applied fatigue management strategies (TP 14573E)
- an employee competency assessment workbook (TP 14574E)
- a guide aimed at assisting the person/committee responsible for the FRMS design and implement the FRMS (TP 14575E)
- a trainer’s handbook (14578E)

Use of these tools is not mandatory. They provide foundations and guidance material for the implementation of an FRMS. Organizations choosing to use the toolbox should tailor the contents to meet the requirements of their organization based on their own unique operating environment.

All employees should be provided with the introductory booklet when the company decides to implement an FRMS. This booklet can also be provided to new employees in advance of scheduled training.

All employees should also complete a formal training course that includes face-to-face training and a competency-based workbook. Face-to-face training allows employees to ask questions about their responsibilities within the FRMS and how it affects the work environment. The competency-based workbook ensures that employees have understood the information and can apply the knowledge and skills to their own work environment. The training is also available online at www.shiftwork.com.au which features an automatic assessment tool.
Employees involved in the design, implementation, and/or evaluation of the FRMS (such as senior management staff, the person responsible for the FRMS or FRMS committee members) should follow a more advanced level of training. This should outline what an FRMS is, the specific elements that need to be included in an FRMS, and how to tailor the FRMS to suit operational needs. This is detailed in Developing and Implementing a Fatigue Risk Management System (TP 14575E).

A trainer’s handbook has been developed to help organizations who wish to maintain the in-house capacity to deliver face-to-face training on fatigue management for employees. It provides background information for delivery of the employee training workshop, including learning outcomes, questions frequently asked by participants, as well as additional reference material.

**Points to Consider**

- What level of fatigue-related training already exists within the organization?
- What are the major topics that should be covered in fatigue-related training?
- Do different work groups require different levels of fatigue-related training?
- How will fatigue-related training be delivered (e.g., posters, video, face-to-face, readings, workbook, website)?
- How often should fatigue-related training be conducted?
- How will fatigue-related training be recorded and maintained?
- How will the training be given (i.e., process, people)?

---

**SAMPLE TEXT**

[Insert company name] is committed to creating an informed safety culture. This is particularly important for consultations with employees regarding fatigue risk management. To this end, training programs will be provided to employees.

All employees will receive a two-hour face-to-face training session with a qualified trainer. This session will include:

- basic information about fatigue and fatigue management strategies
- information on the impact of fatigue on specific operational tasks
- organizational responsibilities within the FRMS
- individual responsibilities within the FRMS
- control mechanisms for fatigue
- fatigue-proofing strategies
In addition to the face-to-face training, employees will be required to complete a workbook on Fatigue Management Strategies for Employees to ensure that they understand the issue of fatigue at [insert company name] and their responsibilities.

All employees will be required to sign and date a training form, and will be provided with a certificate on completion of the competency-based exercises. These records will be maintained by the person responsible for the FRMS.

Refresher training will be given to employees every two years. This will also provide employees with the opportunity to comment on the effectiveness of the FRMS and to suggest potential changes to the system.

Senior management, the person/committee responsible for the FRMS will be required to complete training based on Developing and Implementing a Fatigue Risk Management System (TP 14575E).
Fatigue-related impairment is likely to change with operational demands, organizational culture, and employee turnover. It is important that the FRMS be continually reviewed and improved to ensure that it is operating effectively. All the major components of the FRMS and levels of control should be reviewed, including:

- Policy
- FRMS Committee
- Communication and consultation
- Implementation process
- Schedule and actual hours of work
- Assessment of actual sleep obtained
- Training and education
- Delivery of training and education
- Incident and accident investigation
- Internal audits

Among other aspects, the review process should consider the following:

- Is the FRMS manual clear and up to date?
- Has everyone been provided with fatigue-related information and received the appropriate training?
- Is the FRMS able to identify and deal with fatigue-related hazards before they result in an error or incident?
- Is the FRMS able to adapt to changing operational demands, scheduling changes, and contingency situations?
- Is the reporting system adequate for identifying fatigue-related hazards?
- Is there an internal investigation and auditing system in place, and is it working?
- What feedback has been obtained from safety audits and from error and incident reports?
- What feedback has been provided by employees, contractors, and clients about the system?

As part of the FRMS review, it is also useful to look at annual expenditures on the FRMS. In calculating the cost of FRMS, include factors such as person-hours devoted to implementing and maintaining the FRMS and absenteeism due to fatigue.

Major design and implementation expenses normally occur in the first year. It is possible that absenteeism due to
fatigue will increase slightly at the beginning as employees become more aware of fatigue as a potential hazard. However, it is likely that employees who feel impaired by fatigue already call in sick under normal sick leave conditions – the FRMS will probably help highlight existing causes of absenteeism.

The review may find that employees need to be encouraged to participate more actively in the FRMS. Employees who hold key leadership roles within the organization could be approached to promote the FRMS. Similarly, employees who have been proactive throughout the review period in FRMS (e.g., reporting events, involvement in the FRMS committee, promoting fatigue countermeasures) could be formally acknowledged in corporate newsletters.

**Points to Consider**

- How often will the FRMS be reviewed?
- Who will be responsible for collecting data and overseeing the review process?
- How will the FRMS be reviewed?
- What will be done with information obtained through the review process?
- How will results of the review be communicated to employees?

The FRMS will be reviewed and updated after the first year of implementation. Following the post implementation review, the FRMS will be reviewed and updated every two years.

The Accountable Executive will appoint an independent person to be responsible for providing oversight for the FRMS review process. The review should include all aspects of the fatigue risk management system including (where applicable) the following components and operational responsibilities:

-Schedulers are required to maintain accurate records of planned and actual work hours for assessment with the FAID program.
- Payroll personnel are required to record reasons for absenteeism to assess any trends due to fatigue.
- Employees are required to complete a two-week sleep diary twice a year (which will be kept confidential from company management) to assess current sleep habits (see form in Section 7). This will be coordinated by the person responsible for the FRMS.
- Supervisors are required to report any instances where employees may be at risk of making a fatigue-related error due to insufficient sleep opportunity, insufficient sleep, or fatigue-related symptoms using the fatigue occurrence database (see Section 3.7). This data will be analysed for any trends and used for further improvement of the FRMS.
- Employees and supervisors are required to report any errors or incidents that may have been fatigue related using the reporting system outlined in the SMS policy. This data will be analysed for any trends and used for further improvement of the FRMS.
- Employees and supervisors are required to participate in incident investigation procedures, and provide data to investigators regarding work schedules, sleep obtained, and symptoms prior to the event. This data will be analysed for any trends and used for further improvement of the FRMS.
- The person responsible for the FRMS will conduct focus groups with a representative sample of employees to obtain feedback about the effectiveness of the FRMS.
- The person responsible for the FRMS will keep a record of all costs and benefits that result from the FRMS. This may include but is not limited to financial gains/losses, employee morale, and frequency of errors, lost time injuries, and fatalities.

After the review process, the Accountable Executive will review the findings and the FRMS Committee will meet to discuss the results and any potential changes to be made to the FRMS. The results of all FRMS reviews, together with any actions taken to improve the FRMS, will be kept on file for Transport Canada to review in the auditing process. Any changes made to the FMRS policies and procedures document will be recorded using the manual amendment process, outlined in Section 1.2.
CHAPTER 6

Appendices

Attach any supporting documents here. This may include:

- Relevant safety manuals
- Relevant CARs or guidance notes from Transport Canada
- Sleep diary form for collecting data
- Symptom checklist
- Description of the fatigue occurrence reporting form or database
- Additional reading material that may be of particular interest to employees

Points to Consider

- Is there any information that users of the FRMS manual will require easy access to?
## Sleep Diary

### Sleep Diary – FRMS Study

Month & Year: ........................................... Name: .............................................

<table>
<thead>
<tr>
<th>Start Date/ Time ddhhmm</th>
<th>Pre-sleep Fatigue Level</th>
<th>End Time hhmm</th>
<th>Post-sleep Fatigue Level</th>
<th>Sleep Quality</th>
<th>Remarks</th>
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<tbody>
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<td></td>
<td>Broken sleep due to sick child</td>
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<td>20</td>
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</tbody>
</table>
Instructions

1. Please complete a single line of the sleep diary for each attempted or actual sleep period (i.e., major sleeps and naps) even if you do not actually fall asleep.

2. Record start date/time and pre-sleep fatigue level immediately prior to "lights out." Start time is the time that you start attempting to sleep (i.e., "lights out") not the time that you fall asleep.

   **Note:** start/end times should not include time spent reading, watching TV, etc.

3. Record end time and post-sleep fatigue level approximately 20 minutes after the sleep period ends. End time is the time that you get up or start reading, watching TV, etc., in bed. It may differ from wake up time.

4. Rate the quality of your sleep compared to a "normal" sleep period.

5. Make any relevant comments (e.g., regarding the sleep environment, interruptions, ambient noise, etc.).

---

**Fatigue Level**

1. Fully alert, wide awake  
2. Very lively, responsive, but not at peak  
3. Okay, somewhat fresh  
4. A little tired, less than fresh  
5. Moderately tired, let down  
6. Extremely tired, difficulty concentrating  
7. Completely exhausted, unable to function effectively

**Sleep Quality**

1. Very good  
2. Good  
3. Average  
4. Poor  
5. Very poor  
6. Did not sleep
**Symptom Checklist**

Name: ............................ Date: ........................ Circle: Pre/Post Shift

**Fatigue-related Symptoms**

<table>
<thead>
<tr>
<th></th>
<th>Physical</th>
<th></th>
<th>Mental</th>
<th></th>
<th>Emotional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yawning</td>
<td></td>
<td>Difficulty concentrating</td>
<td></td>
<td>More quiet or withdrawn than normal</td>
</tr>
<tr>
<td></td>
<td>Heavy eyelids</td>
<td></td>
<td>Lapses in attention</td>
<td></td>
<td>Lacking in energy</td>
</tr>
<tr>
<td></td>
<td>Eye-rubbing</td>
<td></td>
<td>Difficulty remembering what you are doing</td>
<td></td>
<td>Lacking in motivation to do the task well</td>
</tr>
<tr>
<td></td>
<td>Head drooping</td>
<td></td>
<td>Failure to communicate important information</td>
<td></td>
<td>Irritable or grumpy behaviour</td>
</tr>
<tr>
<td></td>
<td>Micro-sleeps</td>
<td></td>
<td>Failure to anticipate events or actions</td>
<td></td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td>Accidentally doing the wrong thing (error)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Accidentally not doing the right thing (omission)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Other</td>
<td></td>
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</tbody>
</table>
CHAPTER 7

Further Reading


Talk about Sleep website: www.talkaboutsleep.com

Fatigue Risk Management System
for the Canadian Aviation Industry

Trainer’s Handbook

April 2007
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Notices

This report reflects the views of the authors and not necessarily the official views or policies of Transport Canada.

Transport Canada does not endorse products or manufacturers. Trade or manufacturers’ names appear in this report only because they are essential to its objectives.

Une traduction de ce document est également disponible en français : «Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Manuel du formateur», TP 14578F.
Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada through a contract with edu.au of Adelaide, Australia.

The FRMS toolbox consists of six components:

1. **FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue**, TP 14572E: introductory material intended to raise awareness about fatigue

2. **FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees**, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. **FRMS for the Canadian Aviation Industry: Employee Training Assessment**, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. **FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System**, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. **FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines**, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. **FRMS for the Canadian Aviation Industry: Trainer’s Handbook**, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants
Contents

How to Use This Handbook .................................................................................1
  Purpose of the Trainer’s Handbook ..............................................................1
  Format of the Training ..................................................................................1
  Slideshow Presentation ................................................................................2
  Speaking Notes ..............................................................................................2
  Prepare for the Workshop .............................................................................2
  Training Techniques .....................................................................................2

Frequently Asked Questions ............................................................................3

Reference Material ..........................................................................................7

Appendix A – Slideshow Presentation
How to Use This Handbook

Purpose of the Trainer’s Handbook

An important part of a fatigue risk management system (FRMS) consists of training all employees in the management of fatigue as a safety hazard. Training materials have been designed to meet the business needs of participating organizations and the skills development needs of their employees in relation to fatigue risk management.

This handbook is intended to provide you, as a trainer, with the tools and strategies to prepare and deliver the face-to-face component of the employee training, Fatigue Management Strategies for Employees:

- slideshow presentation
- speaking notes
- information on how to prepare the workshop
- frequently asked questions
- bibliography of reference material

Format of the Training

The slideshow presentation is structured so that it can be tailored to different employee groups (e.g., maintenance employees, flight crew, cabin crew). The presentation provides a good overview of fatigue risk management and is intended to be used in conjunction with the paper- or web-based employee training tools and assessment to ensure that participants have understood and can apply the knowledge presented in the workshop.

The presentation is most effective for groups of 10 to 20 people to allow for participant interaction. Participants in groups this size tend to retain more knowledge and get greater benefit from the face-to-face training sessions.
Slideshow Presentation

The most important component of this handbook is the slideshow presentation (see Appendix A). The presentation is approximately 180 minutes long, and has been divided into three modules:

1. Causes and Consequences of Fatigue
2. Fatigue Risk Management
3. Personal Fatigue Countermeasures

The presentation should be casual, and participants encouraged to ask questions and/or share personal anecdotes. Group activities are provided throughout to encourage interaction. You should use a whiteboard or flipchart to document participant responses to the group activities.

Training Techniques

As a trainer, it is important to understand that different people learn in different ways. It’s important to incorporate a variety of training techniques within your presentation style. Get the group participating through class discussion, group activities, anecdotes from participants, etc.

Help the group retain the information presented by repeating it and by illustrating the discussion using examples or analogies.

Remember that the training is competency-based rather than awareness raising. Participants should demonstrate that they can apply the skills presented in the workplace.

Prepare for the Workshop

You should be familiar with the organization’s FRMS. Review the training material and make changes as required to ensure the slides are consistent with company policy. Pay particular attention to slides 19 and 20, which are intended to outline the specific responsibilities of employees and management under the organization’s FRMS.

Make yourself familiar with the training material – in particular, the frequently asked questions section of this handbook. It’s a good idea to become familiar with the other manuals, guides, and workbooks in this series. Consult the list of reference material if you would like to know more about certain topics.
1. Why so much emphasis on mental fatigue? Isn’t physical fatigue equally important?

Physical fatigue can impair physiological and psychological performance in a similar way to mental fatigue. However, unlike mental fatigue, physical fatigue can be managed with rules governing hours of service. Mental fatigue, on the other hand, is more complex and needs attention on many different levels. Using a systems-based approach to managing mental fatigue will also manage physical fatigue.

2. Is it true that older people need less sleep than younger people?

It is true that older people get less sleep than younger people. However, there is no evidence that they need less sleep. As we age, it is common for our sleep patterns to change. While the overall amount of sleep we get remains roughly the same, older people tend to wake more often during the night and get their sleep in shorter blocks. Age also brings hormonal changes that affect the type of sleep we get – older people experience less REM (dreaming) sleep than younger people. This is one of the reasons that adapting to shiftwork becomes more difficult as we get older.

3. How do you determine whether fatigue is a factor in accidents?

In accident statistics, fatigue is generally inferred from the time of day that the incident took place (midnight to 6 a.m.). Single vehicle accidents in which suicide has been ruled out are also included. Other factors that are considered include time on task (greater than 9 hours) and the work schedule of the previous seven days. You can see that this is not very exact – the contribution of fatigue to accidents is probably underreported.
4. **When you look at the graph showing performance after being awake for a long time (Slide 12), why does performance start to go back up after being awake for 24 hours?**

   This is a demonstration of the effect of the body’s circadian rhythm. When the sun rises, our body “resets” (to a degree), and performance improves as the body naturally wakens and becomes active. Many people call it getting a second wind. However, it’s not likely that performance will reach the same level as the previous day.

5. **Can performance testing be used in the workplace as a check of fitness for duty?**

   Some workplaces may use performance tests for exactly that. However, there are a number of limitations. First, every employee must be tested against his or her own baseline (when they are not fatigued). Second, performance testing requires a lot of data management, and supervisors and employees need feedback right away. Third, it is difficult to draw a line at which an employee is “unfit for duty” based on the test. Tests can be used as a tool to determine how often and under what conditions employee performance is worse than normal.

6. **Isn’t an FRMS just dictating to employees what they do in their time away from work?**

   An FRMS is not about controlling employees’ lives, but it is about setting an expectation that they arrive at work fit for duty. This includes managing their time away from work to ensure they receive adequate rest and sleep. If, for whatever reason, employees aren’t able to get enough rest, it is their responsibility to report it as a potential risk. It’s no different from rules about the number of hours you must wait between drinking alcohol and starting work.

7. **You say individuals need 5-6 hours sleep to sustain appropriate levels of performance. What if an employee maintains he or she only requires 2 hours sleep a night, and feels perfectly fine?**

   Research has found that most people need 5-6 hours sleep. A small percentage of people can get by on less. More often what happens is that people get used to functioning on less sleep. Their standard of feeling wide awake and alert drops, and they get used to living and performing at a lower level of alertness. It becomes normal. When these same people take a long holiday, they usually sleep a lot more than 5 hours and feel a lot more alert. If you consistently report getting less than 5 hours’ sleep, but don’t display any fatigue-related symptoms, you’re not likely to be a significant risk to the organization. However, conduct an experiment and try to get 6-8 hours sleep for a couple of weeks. If you feel a positive difference in your level of alertness, you should aim to get this much sleep on a more regular basis.
On the other hand, if you still feel you can get by on less than 5 hours of sleep, you should consider seeing a doctor to find out whether your performance is really as good as it could be, or whether you may have a sleeping disorder.

8. How do I know if I have a sleep deficit?

Besides feeling tired all the time, one of the major signs of sleep deficit is sleep latency – how long it takes you to fall asleep. A normal sleep latency is approximately 15 minutes. If you need a lot less to fall asleep, it may mean that you have a sleep deficit – particularly if you fall asleep within one or two minutes, or find yourself falling asleep unintentionally. If you take a lot longer to fall asleep, you may be suffering from insomnia.

9. Is there an ideal length for a nap?

If you are really fighting sleep, and are trying to perform a job that involves any level of risk (e.g., driving, engine overhaul, refuelling), any nap is better than no nap. Research has found that naps as short as 10 minutes can be effective in increasing alertness. The longer the nap, the longer the benefits will last. However, longer naps are also associated with longer periods of sleep inertia (that groggy feeling when you wake up) afterward. When napping is permitted in the workplace, it should be limited to about 40 minutes.

10. Caffeine doesn’t seem to affect me at all – in fact, if I don’t have a coffee before bed, I wake up with a headache. Why is that?

Caffeine is only effective when used strategically. People who regularly drink caffeine will not get the same level of stimulation as people who only drink caffeine when they are tired and need a kick. Caffeine is addictive. Regular caffeine drinkers who suddenly stop often experience headaches, dizziness, and/or nausea. If you wake up with a headache if you don’t have a coffee before bed, it may mean that your body is over-dependent on caffeine.

11. I find that rolling down the window or listening to the radio or chewing gum helps me to stay awake when driving home. How effective are these strategies for reducing the risk of a fatigue-related accident?

Contrary to popular opinion, these techniques for staying alert while driving are not enough to safeguard you against falling asleep at the wheel or causing an accident. Driving fatigued impairs your performance in a similar way that driving drunk does. Even if you think you’re okay, bear in mind that sleep can come when you’re not expecting it. You are not always able to accurately judge just how sleepy you really are.
12. Why do we need to sleep?

Scientists don’t know the exact reason we need to sleep, although it is clearly necessary to allow the body to recover from the stresses of the day. Humans that have suffered prolonged sleep deprivation experienced symptoms such as hand tremors, slurred speech, increased sensitivity to pain, and reduced mental and physical performance.

13. When is the human body most susceptible to the effects of fatigue?

The lowest point in the circadian rhythms that affect the body’s alertness is between 2 a.m. and 6 a.m. If you wake from a nap in this period, remember that you’re likely to experience long sleep inertia. If you’re awake during these times, your alertness may be affected.

14. Why is fatigue receiving so much attention now, when it has never been an issue in the past?

First, our understanding about the risks associated with fatigue has evolved a lot in recent years. And as more and more people take up shiftwork and other alternative working arrangements, the potential for fatigue-related accidents increases. This risk is made worse by the increasing use of high-powered machinery, where the margin for error is lower and the consequences of accidents potentially very serious.

15. Would you encourage the use of sleeping pills as an aid to getting enough sleep in time away from work?

If you cannot sleep at all, or have a lot of difficulty getting to sleep, sleeping pills can be an effective strategy to retrain your body to sleep. However, you shouldn’t use them over the long term. You can develop a dependency on sleeping pills after just one week. Long-term use of sleeping pills can cause irritability, headaches, nausea, depression, muscle loss, and increased appetite. You should use them only for short periods.

16. Does shiftwork have any impact upon pregnancy?

Although the effects of shiftwork on pregnancy are slight (only marginally higher than for day workers), there are some effects that are worth being aware of. Some types of shiftwork have been linked to increased time to conception, increased risk of premature birth, lower rates of foetal growth, and increased risk of miscarriage. Although these risks are slight, you may wish to discuss them with your doctor.
## Reference Material

<table>
<thead>
<tr>
<th>General Topic</th>
<th>References</th>
</tr>
</thead>
</table>
| Background to Fatigue | Batelle Memorial Institute (2002) *An Overview of the Scientific Literature Concerning Fatigue, Sleep, and the Circadian Cycle.*  
| Sleep                 | Eastern Perth Public and Community Health Unit, Royal Perth Hospital & the Alcohol and Other Drugs Program, Public Health Division, Department of Health (2005) *A Good Night’s Sleep*, Department of Health, Government of Western Australia.  
*Common Sleep Disorders*  
www.clevelandclinic.org/health/health-info/docs/3300/3373.asp?index=11429  
*Sleep Disorders*  
www.healthieryou.com/sleep.html |
<table>
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<tbody>
<tr>
<td>Psychosocial Consequences of Shiftwork</td>
<td>Bültmann, U., Kant, I.J., van den Brandt, P.A. &amp; Kasl, S.V. (2002) 'Psychosocial work characteristics as risk factors for the onset of fatigue and psychological distress: Prospective results from the Maastricht Cohort Study', <em>Psychological Medicine, Vol. 32</em>, pp. 333-345.</td>
</tr>
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</tr>
</tbody>
</table>


Sleep Hygiene

www.sleepfoundation.org/site/c.huIXKjMOLxF/b.2422637/k.8FF1/Sleep-Hygiene.htm


Napping


### Caffeine & Other Stimulants


### Nutrition


*Over Consumption of Sugar Causes Fatigue*
www.naturalways.com/sugar.htm

### Exercise

Sobel, D.S. *Exercise Improves Sleep.*
www.healthy.net/scr/article.asp?ID=424

### Relaxation

*Relaxation Techniques*
www.ummm.edu/sleep/relax_tech.html#Progressive%20Relaxation

### Other Useful Sources of Information

<table>
<thead>
<tr>
<th>Website</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>University of South Australia, Centre for Sleep Research</td>
<td>General information, reports and papers about sleep and fatigue <a href="http://www.unisa.edu.au/sleep">www.unisa.edu.au/sleep</a></td>
</tr>
<tr>
<td>Transport Canada</td>
<td>General information and regulatory advice about fatigue risk management <a href="http://www.tc.gc.ca">www.tc.gc.ca</a></td>
</tr>
<tr>
<td>National Sleep Foundation</td>
<td>General information and quizzes about sleep and fatigue <a href="http://www.sleepfoundation.org">www.sleepfoundation.org</a></td>
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<tr>
<td>NAPS database</td>
<td>Search scientific abstracts about sleep and fatigue</td>
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<td><a href="http://www.websciences.org/bibliosleep/naps/">www.websciences.org/bibliosleep/naps/</a></td>
</tr>
<tr>
<td>PubMed</td>
<td>Search scientific abstracts about sleep and fatigue</td>
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<tr>
<td>Drew Dawson's Homepage</td>
<td>General information, industry reports and PowerPoint presentations about fatigue risk management</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.drewdawson.com">www.drewdawson.com</a></td>
</tr>
</tbody>
</table>
Appendix A

The most important component of this handbook is the slideshow presentation. The presentation is approximately 180 minutes long, and has been divided into three modules:

1. Causes and Consequences of Fatigue
2. Fatigue Risk Management
3. Personal Fatigue Countermeasures

The presentation should be casual, and participants encouraged to ask questions and/or share personal anecdotes. Group activities are provided throughout to encourage interaction. You should use a whiteboard or flipchart to document participant responses to the group activities.
Training Outline

Goal: To provide you with the knowledge and skills to manage fatigue-related risk
1. The causes and consequences of fatigue
2. Fatigue risk management system
3. Personal fatigue management strategies

As the workforce moves increasingly toward shiftwork and alternative working arrangements, the potential for fatigue-related risks increases.

This problem is compounded by the growing use of complex, high-powered machinery, where the margin for error is small and the potential for serious injury is high.

This training will give you an overview of:
• what causes fatigue and the risk it poses in the workplace;
• how a fatigue risk management system can reduce the risk; and
• some strategies you can use to manage your own fatigue and reduce the risks in the workplace.
Causes and Consequences of Fatigue

Module One
What is Fatigue?

• A state of physical or mental weariness that results in reduced alertness
• The result of a lack of adequate sleep
• A sleep debt that accumulates until paid off with adequate sleep

Quantity and quality
Fatigue largely results from an inadequate *quantity or quality* of sleep. The quality of sleep is also important to maintain your normal alertness and performance.

Sleep debt
If you don’t get enough sleep (quality or quantity) over a series of nights, you’ll build up a sleep debt. Losing an hour or two of sleep a day for several days can leave you as fatigued as missing an entire night’s sleep. Many people sleep an extra hour or two on their day off – they’re paying off their accumulated sleep debt.

A sleep debt can only be repaid with adequate recovery sleep – the sleep your body normally needs to function.

Feelings of fatigue can also be brought on or made worse by conditions in your workplace, such as:
• high-pressure demands,
• long shifts,
• stress,
• not taking breaks during your shift, and
• even poor lighting, constant noise, or bad weather conditions.
What are some conditions that make you feel particularly tired or fatigued at work?

You may want to make a list on a whiteboard or flipchart. Get the group to divide the conditions into two lists: work and non-work factors.
Causes of Fatigue

Fatigue can be the result of a variety of factors:
- the body’s natural rhythms
- work schedule
- type of task
- work environment
- non work-related issues

Body rhythms
Your body clock – also called your circadian rhythms – programs you to sleep at night and be awake during the day. It can be difficult to get good quality sleep during the day when your body wants to be awake.

Work schedule
When you work and how much time you have between shifts affect how much opportunity you have to sleep. Working through the night, long shifts, many shifts in a row, and short turnaround reduce the time you have for sleep and increase the likelihood you’ll become fatigued.

Type of task
Some tasks are more fatiguing than others – complex, demanding tasks and boring, mundane tasks increase feelings of fatigue.

Work environment
Loud noise, poor lighting, heat or cold, vibration, or humidity increase feelings of fatigue.

Non work-related factors
Balancing shiftwork with family and social life can be stressful and make it hard to get adequate sleep. Family demands (e.g., illness) or personal problems (e.g., divorce) increase stress and the likelihood of becoming fatigued.
The Body Clock

- Known as **circadian rhythms**
- Operates on a 24-hour cycle
- Makes you sleepy when it’s dark and awake when it’s light
- Controls a variety of body functions:
  - Sleepiness
  - Digestion
  - Hormone production
  - Body temperature

It’s not just because we’ve had a long day and we’re tired that we go to sleep. Your body clock actually controls feelings of sleepiness, telling your body to go to sleep when it gets dark, and to wake up when it’s light.

**Light and dark are triggers**
That’s one reason your body finds it difficult to adjust to night or evening shifts – you’re working when your body clock is trying to send you to sleep.

Your body does this in a variety ways, such as:
- secreting hormones (e.g., melatonin) that help induce sleepiness, and
- lowering your core temperature, which also makes you sleepy.

**Other body rhythms**
When you work at night, you’re also fighting against other body rhythms, such as digestion. Your body’s digestive system slows down when you’re normally sleeping, so eating at night forces your body to digest food it’s not ready for.

This is why shiftworkers are more likely to experience fatigue and gastrointestinal problems.
Alertness follows a similar curve – as body temperature rises, you become more alert and performance improves. As your temperature falls in the evening, you feel sleepier.

The sleepiness curve

Alertness follows a similar curve – as body temperature rises, you become more alert and performance improves. As your temperature falls in the evening, you feel sleepier.

The lowest point of the temperature curve occurs between 3 a.m. and 5 a.m., which is a particularly difficult time to stay awake.

Feeling sleepy after lunch – known as the post-lunch dip – is also part of the body's normal rhythms. It has nothing to do with whether you had a big lunch.

Individual differences

The ability to cope with shiftwork varies from person to person, depending on their individual circadian rhythms. That's why people can generally be divided into morning or evening types.

Morning people adapt better to early morning hours but have more trouble coping with night work. Evening types cope more easily with evening and night shifts. They tend to cope better with shiftwork overall since they generally have less rigid sleep habits and find it easier to catch up by sleeping late in the morning.

We function best when we follow our body’s natural pattern of sleep and wakefulness.
• Most people need between 7 and 9 hours per day.
• It’s not true that you need less sleep as you get older.
• When you sleep makes a difference in how much you get.
• Sleep is best obtained in a single block.

How much?
It varies from person to person – most people need between 7 and 9 hours per day.

Sleep and aging
As you get older, it becomes physically more difficult to stay asleep across a sleep period without waking up. Aging brings disruptions to your body clock, and things like an aging bladder can wake you up more often in the night.

When to sleep
Most people fall asleep naturally somewhere between 10 p.m. and 7 a.m. Sleeping outside these times is more difficult, more broken. Some research suggests that nightshift workers get one to three hours less sleep per day than dayshift workers. In addition to sleeping less, people who work shifts often get sleep of a lower quality.

A single sleep block
Sleeping undisturbed for eight straight hours allows your body to regulate how much of each stage of sleep it gets. However, split sleep, or a number of short sleeps, is better than not getting any at all.
Sleep Cycles

When you sleep, you cycle through five different sleep stages.

Five sleep stages

Stage 1 is the transition between consciousness and sleep. You can generally hear and respond to someone.

Stage 2 is a light sleep. You are easily awakened but you're not aware of your surroundings.

You spend about half your sleep time in stages 1 and 2.

Stages 3 and 4 are deep slumber – this is a very restorative phase.

Stage 5 is known as REM or rapid eye movement sleep, and it’s the stage of sleep where you dream. Researchers believe your eyes move at this stage of sleep because you’re scanning the images in your dreams. It’s thought to be important for learning and consolidation of memory.

A complete cycle can last between 60 and 90 minutes.

A typical sleep will move through the cycle several times, but each cycle will vary in length.

Whenever you’re sleep deprived, your body will try first to catch up on deep sleep (Stages 3 and 4) and REM sleep.
A Serious Safety Hazard

When you’re fatigued:

• your reaction time is slower
• you have trouble concentrating or remembering things
• you may have difficulty communicating clearly with co-workers
• you may fall asleep on the job
• there’s a greater risk you’ll make a safety-critical mistake

Being fatigued can make you a risk to yourself, your co-workers, and the public!

Fatigue and falling asleep have been identified as significant contributors to incidents and accidents.

It has been estimated that between 10 and 40% of all road accidents involve fatigue.

High-risk times for fatigue

There are particular times of the day when the risks associated with fatigue are higher:

• midnight to 6 a.m. (and especially 3 a.m. to 5 a.m.) – the low point in the body’s circadian rhythm that governs alertness and performance
• the beginning and end of shift when handover occurs – fatigue levels can affect communication
• when you work without a break or for a number of hours – the longer you’re on the job, the likelier you are to have accumulated fatigue
• early shift starts (before 6 a.m.)

In general, we are poor judges of our own fatigue. It’s difficult to tell when your fatigue levels have reached a point where it’s no longer safe to work.
Sleep researchers have found that impairment caused by sleep deprivation is similar to alcohol intoxication.

One study involved 40 participants who were kept awake for 28 hours and then given a series of performance tests. On another day, the same volunteers were given one standard drink every 30 minutes until their blood alcohol levels reached 0.10% and then given the same performance tests.

This graph shows the results: after 17 hours awake, you can be as impaired as though your blood alcohol level was 0.05%. After 24 hours awake, your impairment level matches a blood alcohol level of 0.10% – too drunk to drive.

[Performance begins to improve again in the morning, but that’s because your body clock is waking you up again. Your performance would not reach the same level as the day before.]

Shiftworkers are often awake for comparable periods of time. This is particularly true for night workers who come to work after their days off. They wake up in the morning, stay awake during the day, and go to work that evening. This produces the same kind of fatigue impairment.

Shiftworkers who regularly get less than 6 hours’ sleep in 24 hours are likely to have a sleep debt, which will also impair performance.
Consequences for Health

- Fatigue has an impact outside work.
- Studies have found that shiftworkers are more likely to suffer from:
  - irritability, stress, anxiety, and depression
  - gastrointestinal problems
  - cardiovascular illnesses
  - reproductive problems

Irritability, stress, anxiety, depression
These may be worsened by the stress of balancing work and family/social life.

Gastrointestinal problems
Consitpation, indigestion, ulcers – these may be related to the time of day you eat. Eating at night when gastric juices are dormant can disrupt the gastric system. The types of food eaten by shiftworkers (fast food, high carbohydrate snacks) may make this worse.

Cardiovascular illnesses
Studies have found that shiftworkers have a higher risk than day workers of developing cardiovascular diseases such as high blood pressure and coronary heart disease.

Reproductive problems*
Some studies have found that women who work shifts, and night shifts in particular, complain more frequently of:
  - irregular menstrual cycles and more severe menstrual pain
  - prolonged waiting time to pregnancy
  - lower foetal growth and birth weight
  - increased risk of miscarriage
  - pre-term birth

* Note: these differences are statistically small and not well understood. However, working hours should be considered a factor in reproductive health.
Family and Social Life

- Working shifts can make you feel socially isolated – you work while others have fun.
- It can take heavy a toll on family:
  - less involved in daily life
  - harder to organize domestic chores
  - difficulty arranging childcare
  - higher risk of divorce
- You may be tempted to choose social or family activities over sleep.

Social isolation
Many people who work shifts feel socially isolated. You work while friends and family are socializing. Friends may stop calling because they assume you’re not available.

It may be difficult for you to feel part of the community. You are less likely to be a member of a club, attend meetings, or get involved in group activities such as sports.

Effect on family
Balancing family and work can be difficult. It can be frustrating to you and your family that you’re not available to participate. It can be a source of conflict, which can in turn lead to marital difficulties. Conflicts can worsen as the demands of work or family increase.

Social time vs. sleep
If you start to feel socially deprived, you may be tempted to sacrifice sleep to spend time with family and friends. This is a potential safety hazard.

Coping strategies are discussed in detail in Module 3.
Commuting

• One of the most dangerous things you can do while fatigued is drive.

• You may be driving during the very times that your body most wants to sleep.

• Nightshift workers are 4 to 7 times as likely to have an accident driving home.

Some times are more dangerous than others
There are high-risk times and circumstances when you should be more aware of the risk of having a fatigue-related accident:

• Long drives without a break
• Driving home after a long shift
• Driving between midnight and 6 a.m. (biological low point)
• Driving in heavy traffic
• Long stretches of road with low traffic

Strategies to get home safely
You could have a coffee before leaving work, but remember it may affect your ability to get to sleep when you get home.

You could also have a nap before you leave work, but be sure to wait until you’re fully awake before getting behind the wheel.

Drive carefully, don’t speed to get home faster, and PULL OVER if you find yourself fighting to stay awake.
This module describes a generic FRMS. You should tailor each slide to reflect the actual practices and policies of the company.

In recent years, we’ve been better at managing all kinds of workplace risks – things like better material handling, using seatbelts and safety harnesses, and limiting exposure to harmful chemicals.

It’s only recently that we’ve begun to understand the risk posed by fatigue in the workplace. In this module, we’ll explain how fatigue-related risk can be managed within a safety management system (SMS).
A fatigue risk management system involves:

- Policies/responsibilities
- Risk assessment
- Hazard controls/action plans
- Training and education
- Ongoing review and improvement

A fatigue risk management system should fit within existing safety management systems. It should consist of:

**Policies / responsibilities**
A formal policy manual outlining the responsibilities of both the company and the employees in reducing fatigue-related risk, including detailed procedures on dealing with a variety of specific fatigue-related situations.

**Risk assessment**
A formal assessment of the safety hazard that fatigue presents for each work group or each job task. This is used to determine procedures to follow when the risk from fatigue is high.

**Hazard controls / action plans**
The actual procedures and tools that eliminate or minimize the likelihood and/or consequences of a fatigue-related error or incident. This includes clear decision trees for managers and employees when fatigue has been identified as a risk.

**Training and education**
A successful FRMS requires a change in your organization’s safety culture where everyone is aware of the risk from fatigue. Ongoing training and education programs are an important tool to achieve this.

**Ongoing review and improvement**
As your organization’s understanding of its own fatigue risk grows, it needs to be able to adjust its FRMS to better manage fatigue.
Because work-related causes of fatigue are largely under the control of the organization and non work-related factors are controlled by individual employees, both have a responsibility for managing fatigue.

Both employers and employees need to be aware of the risks posed by fatigue on the job, and to take steps to reduce that risk.

These responsibilities are clearly spelled out in any fatigue risk management system (FRMS).

**Work-related**
- hours of work
- length and timing of shift
- number of shifts in a row
- breaks within and between shifts
- time off (providing sufficient sleep opportunity)
- workload (type of task, complexity)
- environment (noise, lighting, heat, humidity, vibration, etc.)

**Non work-related**
- Home situation and lifestyle (e.g., new baby, second job, child care, home renovations, roadwork outside your house, noisy housemates)
- Illness (e.g., cold/flu, sick partner/child, chronic illness, back pain, etc.)
- Sleep disorders (e.g., insomnia, restless leg syndrome, sleep apnea)
Discuss the specific responsibilities of the employer based on the company’s FRMS.

**Employer Responsibilities**

- Appropriate and safe work design, such as schedules that allow for adequate recovery periods during the shift and between shifts
- Ensuring safe work practices, such as scheduling sensible levels of overtime
- Assessment, control, and monitoring of fatigue-related hazards
- Development of policies, procedures and practices to manage fatigue-related risk
- Information and training about fatigue as a workplace hazard
Discuss the specific responsibilities of the employee based on the company’s FRMS.

**Employee Responsibilities**

- Arriving at work in a fit state to work
- Reporting all incidents and accidents, as well as potential fatigue-related hazards
- Maintaining communication with work colleagues, supervisors, managers
- Being aware of fatigue and how to counteract it in the workplace
- Avoiding behaviours that place you or others at risk
An effective fatigue risk management system uses multiple, overlapping levels of control as a defence against fatigue-related incidents. That way, an incident can only occur when all the defensive levels fail.

**This system has 5 control levels**

Level 1: making sure schedules provide employees with enough time off to get the sleep they need

Level 2: determining whether employees actually got the sleep they needed

Level 3: keeping an eye out for anyone who displays symptoms of fatigue on the job

Level 4: strategies to make sure that when fatigue is detected in the workplace, it does not result in errors or incidents

Level 5: an accident or incident investigation procedure that allows the organization to determine whether fatigue was a factor, and if so, how to avoid a repeat incident
Level 1 controls are intended to make sure you get enough time off between shifts to get enough sleep

Schedules are evaluated according to:
- length and timing of shifts
- length and timing of breaks
- number of shifts worked in a row
- number of days off between shifts

Level 1 controls are aimed at ensuring that the work schedule provides you with sufficient sleep opportunity.

It’s not just how much you sleep but when you sleep that affects the quality of rest. Schedules need to reflect that.

We also know that people need time to do other things when they’re not at work besides sleep – you need time to manage other responsibilities, such as family. You need time to relax and socialize. A schedule should take these factors into account.
Level 1 Controls
Sleep Opportunity

Fatigue Likelihood Scoring Matrix for Work Schedules

<table>
<thead>
<tr>
<th></th>
<th>0 points</th>
<th>1 point</th>
<th>2 points</th>
<th>4 points</th>
<th>8 points</th>
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<tr>
<td>a) Total hours per 7 days</td>
<td>≤ 36 hours</td>
<td>36.1 – 43.9</td>
<td>44 – 47.9</td>
<td>48 – 54.9</td>
<td>≥ 55+</td>
</tr>
<tr>
<td>b) Maximum shift duration</td>
<td>≤ 8 hours</td>
<td>8.1 – 9.9</td>
<td>10 – 11.9</td>
<td>12 – 13.9</td>
<td>≥ 14</td>
</tr>
<tr>
<td>c) Minimum short break duration</td>
<td>≥ 16 hours</td>
<td>15.9 – 13</td>
<td>12.9 – 10</td>
<td>9.9 – 8</td>
<td>≤ 8</td>
</tr>
<tr>
<td>d) Maximum night work per 7 days</td>
<td>0 hours</td>
<td>0.1 – 8</td>
<td>8.1 – 16</td>
<td>16.1 – 24</td>
<td>≥ 24</td>
</tr>
<tr>
<td>e) Long break frequency</td>
<td>≥ 1 in 7 days</td>
<td>≤ 1 in 7 days</td>
<td>≤ 1 in 14 days</td>
<td>≤ 1 in 21 days</td>
<td>≤ 1 in 28 days</td>
</tr>
</tbody>
</table>

One way to evaluate a work schedule is to calculate a fatigue score based on factors such as shift lengths, days off, and number of nightshifts.

For example, a 9 a.m. to 5 p.m. work week (5 days in a row) would produce a score of zero. On the other hand, a work schedule of seven 12-hour nightshifts, followed by seven days off would produce a score of 21, which would be considered high.

*The table shown here is an example only. Each company should have its own scoring matrix based on its own assessment of its fatigue risk.*

**Biomathematical modelling**

Instead of using a matrix like this one, some companies use scheduling software that is also capable of analysing the schedule for its fatigue impacts.
This graph shows how some common work schedules might score using this system.

*Each organization should decide its own maximum acceptable score. Companies can assign a lower score for safety-critical tasks that have a higher risk from fatigue, and a higher score for less critical work.*
Level 2 Controls
Sleep Obtained

Level 2 controls are intended to determine whether employees actually got the sleep they needed
- Identifies employees who fail to get sufficient sleep
- Provides a procedure to report fatigue to a supervisor or manager
- Outlines clear steps to take when an employee makes a fatigue report

Level 2 controls are intended to determine whether you actually got the sleep you needed. An FRMS typically requires you to report to your supervisor or manager when you haven’t had enough sleep.

There are a number of reasons you may not get enough sleep:
- Inadequate sleep opportunity – this is a sign that the work schedule wasn’t adjusted properly using Level 1 controls, or that the controls themselves are not effective. Level 1 controls should be reviewed.
- Personal stress – there may be things going on in your life outside work that affect your ability to get adequate sleep – sick children at home, social or family responsibilities, etc.
- Medical problems – cold, flu or even a sleep disorder can affect your sleep.

Some companies set up systems where employees calculate for themselves how much sleep they have had and report when their sleep doesn’t meet the requirements. For example, in a high-risk operation the company may decide that anyone who has had less than 6 hours of sleep in 24 hours, or 12 hours of sleep in 48 hours, or has been awake for longer than 18 hours, must report to the supervisor.
Level 2 Controls
Fatigue Likelihood Score

A simple calculation can give you a fatigue likelihood score.

<table>
<thead>
<tr>
<th>Prior sleep factor</th>
<th>Threshold value</th>
<th>Score</th>
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<tbody>
<tr>
<td>X (sleep in prior 24 hours)</td>
<td>5 hours</td>
<td>Add 4 points for each hour below threshold</td>
</tr>
<tr>
<td>Y (sleep in prior 48 hours)</td>
<td>12 hours</td>
<td>Add 2 points for each hour below threshold</td>
</tr>
<tr>
<td>Z (time awake since last sleep)</td>
<td>Y</td>
<td>Add 1 point for each hour of wakefulness greater than Y</td>
</tr>
</tbody>
</table>

You can do a relatively simple calculation to determine whether you’ve had enough sleep.

X = sleep in the past 24 hours
Y = sleep in the past 48 hours [how many hours of sleep you’ve had over the past two days]
Z = time since your last sleep [how many hours since you woke up]

In general, you are likely to be experiencing some form of fatigue-related impairment if:
- X is less than 5 hours
- Y is less than 12 hours
- Z is greater than Y

In a typical FRMS, these scores may be used to determine whether your co-workers, your supervisor or your manager should intervene to reduce the risk you may pose to operations.

*The table shown here is just an example. Threshold values are decided by the company based on its own assessment of the fatigue risk for each work group or each task.*
When you report to your supervisor that you haven’t had enough sleep, it is important that everybody understands the procedures in place to manage the risk from fatigue.

This is an example of a decision tree that a company might use to decide what to do if an employee reports not getting enough sleep.

A score of 10 is considered serious – according to this chart, you should be sent home until you’re rested enough to return to work.

There is a whole gamut of measures that companies can take, depending on how serious the fatigue risk is. These range from asking co-workers to keep an eye on you to asking your supervisor to assign you to another task.

*It’s up to each company to decide which measures need to be taken when an employee reports a fatigue score greater than zero.*
In some industries, companies give employees pocket cards that have the fatigue scoring rules on one side and the measures to be taken on the other side. If your company has such a card, discuss it here.
Level 3 Controls
Fatigue Symptoms

What are some of the common symptoms of fatigue?

Make a list on a whiteboard or flip chart. To help provoke some discussion, ask the group to describe how they can tell another person – their child, their spouse, their co-worker – is tired. Discuss which symptoms are physical, mental or emotional.

**Physical:** falling asleep, head nodding, heavy eyelids, rubbing eyes, lack of coordination, dizziness, change in appetite, headache, impaired vision, yawning, etc.

**Mental:** making errors, difficulty making decisions, difficulty concentrating, trouble communicating, short attention span, lapses in memory, slower reaction time

**Emotional:** irritable, unmotivated, lethargic, lacking in energy, quiet, withdrawn
Level 3 controls are intended to identify employees who show signs of fatigue

- symptoms of fatigue indicate an increased risk of fatigue-related error
- employees should watch for symptoms in themselves and others
- a system of reporting allows the company to take measures when the risk is considered high

Many companies teach employees how to identify symptoms, in themselves and others, that may indicate an increased risk of a fatigue-related error. In a typical FRMS, there are clear guidelines about what to do when you spot a co-worker showing signs of fatigue.

For example, if you catch someone yawning three times in 15 minutes, you should bring it to their attention. If it looks like they may fall asleep, you should tell your supervisor.

Making everyone aware of the signs and symptoms of fatigue is another layer of defence against fatigue-related errors and incidents.

Assessing Level 1 & 2 controls
Another reason to report fatigue symptoms is to let the company know that it may need to adjust its Level 1 or 2 controls. If employees are reporting being fatigued, the schedule may not be giving them enough time to sleep or minimum sleep levels are not enough.
Level 4 Controls
Fatigue Proofing Strategies

- Increased supervisor/co-worker monitoring
- Working in pairs
- Double-check systems
- Checklists
- Task rotation
- Additional breaks
- Napping
- Moving critical/monotonous tasks to daytime

Sometimes working conditions likely to produce fatigue are unavoidable – such as working overtime. Companies should have in place a list of fatigue-proofing strategies to reduce the risk. These are just a few examples.

**Increased monitoring, working in pairs, checklists, double-checking**
It can be as simple and informal as more frequent conversations with your supervisor over the course of a shift. Or it can involve more formal procedures for additional, verified supervisory checks on safety-critical work.

**Task rotation, moving critical tasks to daytime**
These can all help ensure that safety-critical work is not at risk from fatigue. Monotonous tasks can worsen feelings of fatigue as much as those that require intense concentration.

**Additional breaks**
A break of 10 to 20 minutes is usually enough to improve your performance in the short term. Research has found that performance starts deteriorating after two hours on high-demand tasks. Use your break to do something to improve your alertness, like getting some fresh air, exercising, or having a coffee.

**Napping**
Some companies have set up a place for employees to take a nap if necessary. Naps should last at least 20 minutes. Don’t forget the sleep interia effect – give yourself 10 to 20 minutes to wake up fully before starting work.
## Level 5 Controls

### Errors and Incidents

Level 5 controls consist of:

- fatigue error or incident reporting system
- Investigation procedures to determine whether fatigue was a cause of an incident
- review of fatigue management controls

Most organizations have formal requirements to report errors and incidents as a part of their safety management system. These should be discussed specifically here.

Level 5 deals with events or incidents that have actually happened.

As part of any investigation into an incident or error, the company should ask at least three basic questions:

1. Did the schedule provide enough opportunity for sleep?
2. Did employees involved in the incidents actually get enough sleep?
3. Did anyone observe any symptoms related to fatigue?

In most FRMSs, these questions aren’t aimed at finding anyone guilty of anything – it’s a way to find out whether the fatigue management controls are actually working.

Some companies use different reporting forms for fatigue than for regular incidents. Some have set up a confidential on-line database to collect information on how often employees don’t get enough sleep, show fatigue-related symptoms, or make a non-reportable error that’s fatigue related.
This module offers some strategies to help you make sure you get the rest you need to be fit for duty.
What strategies do you use to stay alert when you’re working?
Set up your bedroom for sleeping

- Make it as dark as possible
- Make sure the temperature is right: 18°C to 24°C
- Move distractions to another room
- Make sure you won’t be disturbed

Dark
Because light makes your body think it’s time to wake up, your room should be dark.

Temperature
As soon as the temperature falls outside 18-24°C, your body will keep you awake to cool down or heat up as necessary.

Distractions
Try to use your bedroom only for relaxing, sleeping, and sex. Move potential distractions such as televisions and computers to another room.

Noise
Use an answering machine for the telephone. If there are children around, make sure they won’t wake you. If noise is keeping you awake, try using ear plugs. Because noise can sometimes disturb your sleep without actually waking you, some people use “white noise”, such as a fan or an untuned radio, to help dampen other sounds.
Good Sleeping Habits

- Keep to a regular bedtime routine
- Wind down before trying to sleep
- Be careful what you eat or drink before bed
- Don’t toss and turn waiting to fall asleep
- Adjust your bedtime gradually if your shift changes

Routine
Doing little things like brushing your teeth every day in the same order before bedtime can train your body that it’s time to sleep, even if it’s daytime and your body is normally awake.

Wind down
It’s better to relax a little before trying to sleep. A little light exercise can sometimes help, although avoid anything strenuous.

Eating and drinking
Your body is programmed to digest food during the day, so it’s better not to eat a big meal just before bedtime. A light snack may be okay. Avoid anything with caffeine, such as coffee or energy drinks. Alcohol is not a good idea either, because you won’t sleep as deeply and don’t wake up feeling as refreshed.

Don’t toss and turn
If you can’t get to sleep, it’s sometimes better to get up and do something relaxing instead of tossing and turning. Try reading or taking a bath.

Adjusting to new shifts
Try changing your bedtime by an hour or two each day to get your body gradually used to your new shift.
Take a Nap

- Naps can supplement sleep, not replace it.
- Naps 10 minutes or longer can improve alertness, communication and mood.
- The value of a nap doesn’t depend on the time of day.
- Allow 5 to 20 minutes for sleep inertia to pass.

While a nap is no substitute for a good night’s sleep, it can help you recover from fatigue and make you feel refreshed. The benefits of a nap do not last as long as a good, long sleep, however.

How long?
How long you should nap depends on how much time you have available. You’ll feel more refreshed if you wake up naturally at the end of your sleep cycle. A nap should be at least 10 minutes long.

When to nap?
Although the recovery value doesn’t seem to depend on what time of day you take it, it’s easiest to fall asleep when your body is most tired – between midnight and 6 a.m., and mid-afternoon. The recovery value of the nap doesn’t seem to change.

Sleep inertia
Remember that when you wake up from a nap, you may feel groggy and disoriented for up to 20 minutes. This is especially true if you’re wakened by an alarm instead of waking up naturally, or if you awaken from a particularly deep stage of sleep. This is called sleep inertia. Make sure you build in time to wake up properly before taking on anything that requires full concentration, such as driving.
Drink Plenty of Fluids

- Dehydration slows you down and increases feelings of sluggishness.
- Working in heat, air conditioning, or at night can be dehydrating.
- Drinking coffee, tea, soft drinks, or alcohol, and eating salty foods can make you feel thirstier.
- Adults should drink at least 2 litres of fluid a day.

**Makes you feel tired**
When your body is low on water, it tries to conserve what you have left. It slows down your activity and makes you relax – which makes you feel sleepy. Being dehydrated can also make you feel lightheaded and cause headaches.

**Working environment**
You should pay particular attention if you work in a hot, dry, or air-conditioned environment, or if your job is physically demanding and makes you sweat.

**Careful what you drink or eat**
Drinks that contain caffeine or alcohol can actually make you more dehydrated – they’re diuretics, which makes your body flush water from your system. Sugary drinks or fruit juices can make you feel more thirsty.

Eating high-fat or high-salt foods can also make you dehydrated – they require additional water to digest.

**2 litres a day**
Most people don’t drink enough to stay fully hydrated. If drinking water isn’t easily accessible where you work, consider bringing a bottle to work with you.
Caffeine is one of the mostly widely used drugs in our society. Many people use the caffeine in a strong cup of coffee or tea to get their day started and to fight off feelings of fatigue as the day wears on.

### Strategic use of caffeine
If you drink multiple cups of coffee throughout the day – or even one cup at the same time every day – your body adapts to the caffeine and it becomes less effective. Avoid drinking caffeine when you’re not really tired.

You can also buy caffeine pills such as NoDoze.

### Lasts up to 6 hours
It takes about 20 minutes to feel the stimulating effects of caffeine, and they can last for 4 to 6 hours. Avoid drinking caffeine too close to bedtime.

### Dependence and tolerance
Your body quickly builds up a tolerance to caffeine – the more regularly you use it, the more it will take to keep you alert when you really need help. You can also develop a dependence to caffeine. Many people develop withdrawal symptoms such as headaches when they try to go without.

Remember that stimulants only hide or postpone the effects of fatigue. They do not replace the need for sleep.
To make smart use of caffeine, you should be aware of the caffeine content of common drinks or foods.

You should also be aware that the sugar in many caffeinated drinks can actually work against the stimulating effect of the caffeine and reduce your alertness after the initial effect wears off.
### Drugs and Alcohol

- Alcohol can help you relax before bed, but it can also disrupt your sleep.
- Sleeping pills are best used occasionally or for only a few days at a time.
- Cold and flu medication can keep you from sleeping.

**Alcohol**
Some people use alcohol to help them relax before bedtime. While a couple of drinks may help you fall asleep more easily, alcohol tends to disrupt your sleep cycle and often produces a light, restless sleep that leaves you less refreshed.

**Sleeping pills**
Like caffeine, your body can develop a resistance and a dependence. After about a week, you may have difficulty falling asleep without them. Over time, you may need a larger and larger dose.

**Cold & flu medication**
While cold and flu medication that contains pseudoephedrine may dry up your runny nose, it can also act as a stimulant to keep you awake. It may also leave you dehydrated, which will affect the quality of your sleep. Choose a nighttime version if you need to relieve cold symptoms.
Eating Right

- Maintaining blood sugar levels is key to controlling ups and downs in energy levels.
- Eating low-fat, high-protein foods can actually increase alertness.
- High-fat foods can slow you down.
- High-sugar foods can cause your blood sugar to rise and fall quickly.

Being careful about what you eat can play an integral role in maintaining alertness on the job.

Maintaining blood sugar levels is a key to controlling ups and downs in energy. The way blood sugar levels react to food is known as the glycemic index (GI) of foods.

For example, snack bars or sugary foods can give you a rush of energy – a sugar high – but that’s usually followed by a low that makes you feel tired again.

Foods like potatoes, pizza, and white bread have a high glycemic or sugar index and can make you feel sluggish.

Eating a tuna sandwich on brown bread will keep you going longer without getting tired – tuna packed in water is a high-protein, low-fat food, and brown bread has a lower glycemic index than white bread.
Eating Right

High Glycemic Index (GI) Foods
- French fries, doughnuts, muffins, bread (white or whole grain), Cornflakes, rice (white or quick brown), cakes

Low GI Foods
- Fish (canned in water), low-fat dairy (cottage cheese, yoghurt), lean meat (steak, chicken breast, lamb), pasta, All-Bran, porridge, hard boiled eggs, peanuts, lentils, fresh fruit

High GI foods make your blood sugar levels rise and fall quickly, whereas low GI foods make your blood sugar level rise and fall slowly.

High GI foods are ideal when you have been doing physical work or exercise and need energy quickly to recover.

Low GI foods are ideal to keep an already stable blood sugar level from becoming too high or low. Low GI foods are also ideal for raising low blood sugar levels slowly and avoiding the fast drop in blood sugar (and energy) that can occur after eating high GI foods.

Low GI foods are ideal as regular snacks across a shift to help you avoid big changes in your energy levels.
Physical Exercise

- Good for your overall health
- Can help you sleep better and feel more rested
- Helps relieve stress, boost your health, strengthen your immune function, and improve muscle tone and strength
- Any activity that keeps your heart rate elevated for at least 20 minutes is good

Regular exercise helps you sleep well, stay healthy, and feel fit.

It may not be easy to find a regular time to exercise if your work schedule keeps changing, but you don’t need to join a gym or a local sports team to enjoy the benefits of exercise.

Even going for regular walks can help improve your energy levels and stamina, reduce the risk of heart disease and other health problems, and help you feel better and sleep better.

You should avoid heavy exercise one hour before bedtime – let your body unwind and calm down before sleep.
A Healthy, Balanced Life

- Get enough sleep
- Spend time with friends and family
- Enjoy time for yourself
- Stay fit and healthy

Get enough sleep
Remember that it’s your responsibility to get enough rest to be fit for work. And don’t forget that you need to be rested to fully enjoy your family and social time.

Spend time with friends and family
You may have to plan your time more carefully, and make more of an effort to stay in touch with friends. Let your family and friends know your work schedule. Try to plan events well in advance. You may have to organize activities yourself, rather than waiting for others to include you.

Joining a recreational organization can also be a useful strategy to minimize feelings of social isolation. This can be particularly effective for meeting friends who work on a schedule similar to yours. It provides an opportunity to socialize and relax when most other people are working.

Enjoy time for yourself
Take advantage of the fact that you don’t need to compromise or negotiate for time alone to relax, enjoy a hobby, plan a trip or event, get some exercise – or even catch up on some much-needed sleep!

Stay fit and healthy
Get regular exercise and eat a nutritionally balanced diet. Learn to relax, manage your fatigue, and get the sleep you need. Pay attention to your overall health and visit your doctor regularly.
Any questions/comments?