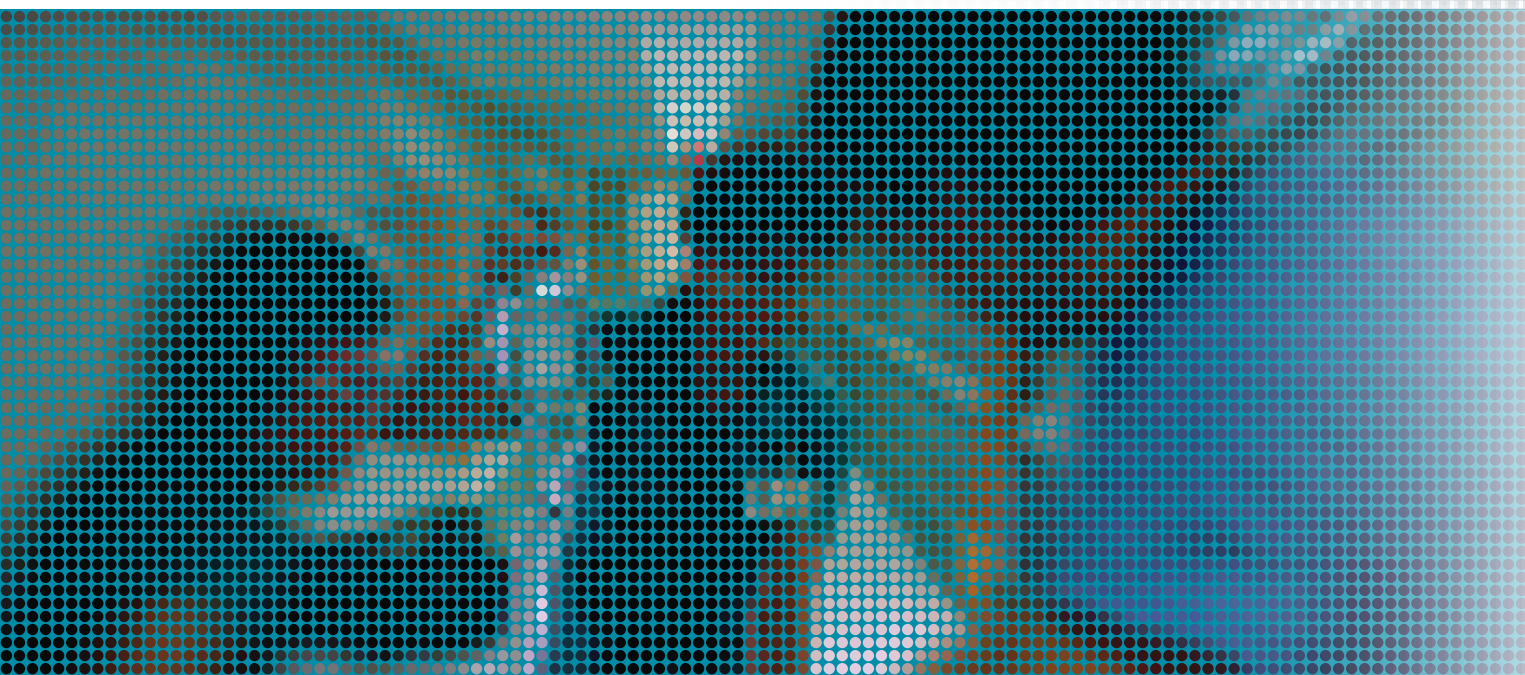


fatigue

risk management system

Resource Pack





Queensland Government
Queensland Health

Fatigue Risk Management System Resource Pack
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Foreword

Queensland Health is presented with many challenges in delivering healthcare services across the state, 24 hours a day, every day of the year.

To meet the needs of patients at any time of the day or night, the doctors and other healthcare workers in Queensland Health facilities often work long hours – throughout the night and on-call over weekends, public holidays and other times of need.

This presents us with the challenge of fatigue and its associated risks to staff and patients.

To meet this challenge, fatigue risk management must be included in our core business operations within Queensland Health.

I encourage all hospital facilities, departments and units to work through this *Fatigue Risk Management System Resource Pack*, to meet employer and employee responsibilities to manage fatigue risk.

Effectively managing fatigue will improve safety, efficiency, productivity and operational flexibility for all involved in our healthcare system.

1

Michael Reid
Director-General
Queensland Health

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Executive summary

Fatigue is a common and unavoidable by-product of the 24-hour delivery of patient care. Defined as a decreased capacity to perform mental or physical work, or the subjective state in which one can no longer perform a task, fatigue manifests in physiological performance decreases and cognitive impairment. To this end, fatigue poses elevated risk to the staff and patients of Queensland Health.

Within the existing Occupational Health and Safety (OHS) legislative frameworks, fatigue is an identifiable workplace hazard that must be managed in the same way as other hazards, like chemicals and heavy machinery. Current legislation highlights the need to provide a safe system of work, which clearly includes effective management of fatigue-related risk.

This *Fatigue Risk Management System Resource Pack* supports facilities in incorporating the risk management of fatigue and fatigue-related risks into core business operations. It is an important element of Queensland Health's systematic approach to managing the risks associated with fatigue. It will result in improvements to our work and workplaces, and meet Queensland Health's duty of care to its staff and the public. As part of this initiative, Queensland Health has released a Medical Fatigue Risk Management Policy, which prescribes that all facilities must develop a comprehensive Fatigue Risk Management System (FRMS).

A FRMS integrates management practices, beliefs and procedures used to manage the risks of fatigue. It provides tailored defences against fatigue-related risks through the use of objective thresholds specifically for local environments.

This Resource Pack is based on scientific knowledge, best practice in other industries and information from Queensland Health case study sites. The five major steps in the development and implementation of a FRMS make up the sections of this Pack.

Determining a governance structure for a facility's FRMS is the initial step of the process. This involves a range of individuals in the roles of District Chief Executive Officer, line managers and supervisors, clinical directors and medical officers. Importantly, this includes establishment of a Fatigue Local Working Group to oversee fatigue-related risk in each facility.

A fatigue scan forms the foundation of the FRMS. This scan identifies acceptable levels and specific incidents of fatigue-related risks. Questions provided will help explore issues such as, where fatigue-related risk is highest, and when, who and how it impacts the facility. Plus, it considers current management of fatigue risks.

The major day-to-day aspects of the FRMS are formed around the Defences in Depth framework. This is where most tailoring occurs for local conditions and solutions. The framework follows a five-level incident trajectory with related hazards and controls. The many practices, procedures, strategies and habits of facilities and departments will likely form a major part of the framework.

Action table examples are provided to document facility thresholds and corresponding controls to address fatigue-related risk. The working time arrangements of rostered hours, actual hours, shift swaps and on-call hours are discussed, along with biomathematical modelling, actual sleep and prior wake.

Finally, an education program is an essential part of the FRMS, either through a web-based education package or detailed instruction through workshops.

Working through this Resource Pack will assist you to develop, design and implement a FRMS that is tailored to your specific working environment. It will help the development of the FRMS document for your facility.

Acknowledgement

We would like to thank the University of South Australia's Centre for Sleep Research for their work in preparing this FRMS Resource Pack, particularly Dr Sally Ferguson, Dr Matthew Thomas, Dr Sarah Jay and Professor Drew Dawson.

The Queensland Health project team for this FRMS Resource Pack included Susanne Le Boutillier, Chantal Casey, Terry Penrose and Sonia Swallow.

We also acknowledge the contributions of staff at the FRMS case study sites of Mount Isa, Cooktown, Mossman, Atherton, Townsville, Mackay, Rockhampton, Redcliffe, The Royal Brisbane and Women's Hospital, Princess Alexandra Hospital, Logan, Gold Coast, Stanthorpe and Millmerran.

Fatigue Risk Management Systems (FRMS) Resource Pack

What's in this Resource Pack and how will it help us?

Working through this Resource Pack will assist you in developing, designing and implementing an FRMS that is tailored to your specific working environment.

This Resource Pack has been designed on the basis of current scientific knowledge, current best practice in other industries, and most importantly for Queensland Health, from information obtained and lessons learned from 14 case study sites. It provides an overview of the FRMS development process, including key steps to take and actions to follow.

The major steps in the implementation of an FRMS are listed below and each of these steps is the focus of a section in this package:

- Define governance structure (Section I, page 18)
- Conduct a fatigue risk assessment (Section II, page 23)
- Design and document Defences in Depth strategies (Section III, page 28)
- Design a training process (Section IV, page 56)
- Complete FRMS document and implement (Section V, page 58).

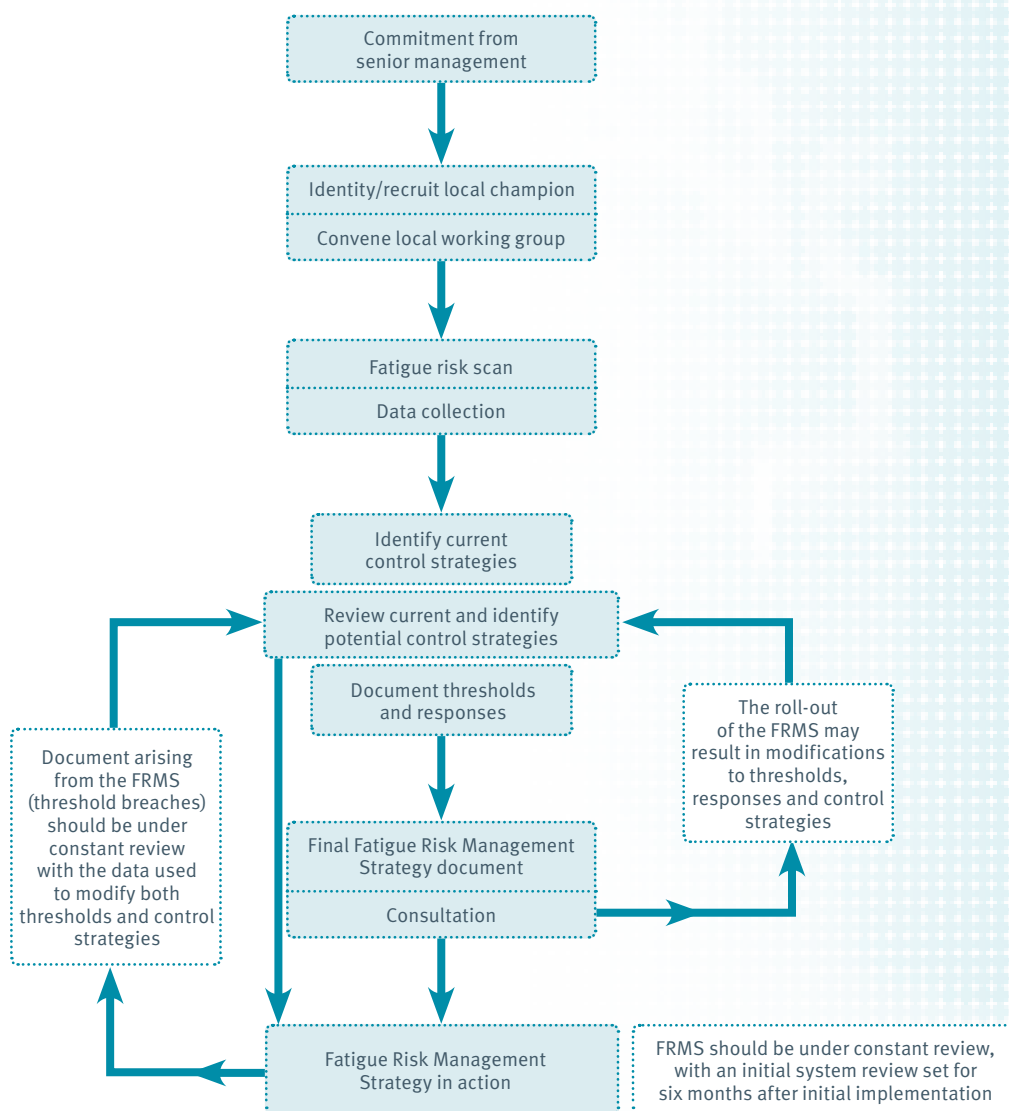
The Queensland Health Medical Fatigue Risk Management Policy defines the minimum requirements for the FRMS. Details about the policy can be found at www.health.qld.gov.au/hrpolicies/other/i_1.pdf.

What are the steps in the implementation process?

The flowchart below outlines the major steps that facilities need to progress through to implement, and continue to monitor, a tailored FRMS. Each of these steps are discussed in more detail through this pack

A major component of successful implementations that is not represented in this figure is the underlying culture into which an FRMS is introduced. Certainly, commitment from senior management, an active Local Working Group and influential and prominent Local Champions are important in promoting that culture. However, promoting a workplace environment in which fatigue-related risk is managed by all individuals is essential. Appendix 1 has further information about encouraging a culture in which the shared responsibility of fatigue risk management can be successful through the management of change.

Major steps for FRMS implementation



What is fatigue?

There are various definitions of fatigue, but for the purposes of this pack, fatigue can be defined as:

A decreased capacity to perform mental or physical work, or the subjective state in which one can no longer perform a task. Fatigue manifests in physiological performance decrements and cognitive impairment.

Fatigue primarily arises as a result of inadequate restorative sleep, but is also influenced by time of day and prior wake.

Thus, the critical factor impacting on fatigue levels is sleep. This Resource Pack contains a detailed review of current literature about sleep deprivation, fatigue and performance changes that can impact safety (see Appendix 5).

Whose responsibility is this?

In short, it is everybody's responsibility. Specific responsibilities will be outlined in detail in your FRMS but in a broad sense the responsibility for managing fatigue-related risk is shared between employer and employees.

Fatigue is an identifiable hazard that we know causes harm to individual doctors and their patients. There is a moral obligation, and under OHS legislation, a legal requirement to effectively manage fatigue-related risk.

**Can we put our hands on our hearts
and say we are currently doing everything
reasonably practicable to manage the risk?**

Occupational Health and Safety (OHS) framework

All employers and employees have responsibilities under the *Workplace Health and Safety Act 1995* for maintaining safe workplaces.

Under the Act and Regulations, once a risk is defined either through an incident or accident, or a risk assessment or hazard assessment, there is an obligation to manage that risk.

The management of fatigue-related risk is a shared responsibility between employee and employer.

Medical Fatigue Risk Management Policy

Queensland Health has released a policy that provides a framework for the development and implementation of a fatigue risk management system (FRMS). The purpose of the policy is to reduce errors and incidents in which fatigue is a contributory factor.

The policy currently resides with HR and will be administered through the Medical Advisory Panel.

The moral obligation

At the end of a long day shift a surgical registrar was asked to stay at the hospital to perform an emergency appendectomy. Due to delays in theatre availability the procedure didn't commence until after midnight. Complications during the procedure led the registrar to ring the senior consultant who was on-call overnight. The consultant who was also the unit director attended and assisted in completion of the case by 3:00am. On leaving the theatre the senior consultant observed the registrar was displaying signs of extreme tiredness but suggested the registrar remain on site to deal with any complications in recovery. The registrar eventually left the hospital at 4:30am and was killed when her car ran off the road and collided with a stobie pole only five minutes from her house. The crash investigation determined she had fallen asleep at the wheel.

The coroner determined that the failure of the senior consultant to act on the obvious signs of fatigue being displayed by the registrar contributed significantly to the death.

Is fatigue something we really need to consider?

In a 24-hour operation, increased fatigue levels are unavoidable. By definition, fatigue-related risk is elevated at night due to circadian factors, and increases with longer time awake (extended work hours). Thus, in Queensland Health facilities in which doctors are required to work long hours and/or night hours or on-call, fatigue-related risk exists.

In 2000 a parliamentary inquiry into fatigue in the transport sector determined that fatigue is a workplace hazard that must be managed in the same way as other hazards, like chemicals or manual handling. While the recommendations of that inquiry were specific to the transport sector, changes are occurring in other sectors and in OHS legislation. These changes will see the management fatigue associated with working time arrangements (or a system of work) soon become mandatory across the majority of workplaces.

Queensland Health has released a Medical Fatigue Risk Management Policy to which all facilities must adhere in the given timeframe.

Risk management of fatigue and fatigue-related risks must be incorporated into Queensland Health's core business operations. In order to facilitate this, Queensland Health has endorsed a systematic approach to managing the risks associated with fatigue. This systematic approach to fatigue risk management will improve safety, efficiency, productivity, operational flexibility and Queensland Health's duty of care to its staff and the public.

Fatigue risk management – the Queensland Health context

In the twentieth hour of a 24-hour shift a fatigued doctor assessed a child who later died of head injuries.

The case is the subject of a coronial inquest and Queensland Health is being required to explain the systems that have subsequently been put in place to manage fatigue-related risk in its hospitals and risk to both doctor and patient safety.

There were significant ramifications for all parties involved in the incident.

What is an FRMS?

An FRMS is an integrated set of management practices, beliefs and procedures for monitoring and managing the risks posed to health and safety by fatigue. It is based in safety management system theory with an emphasis on risk management.

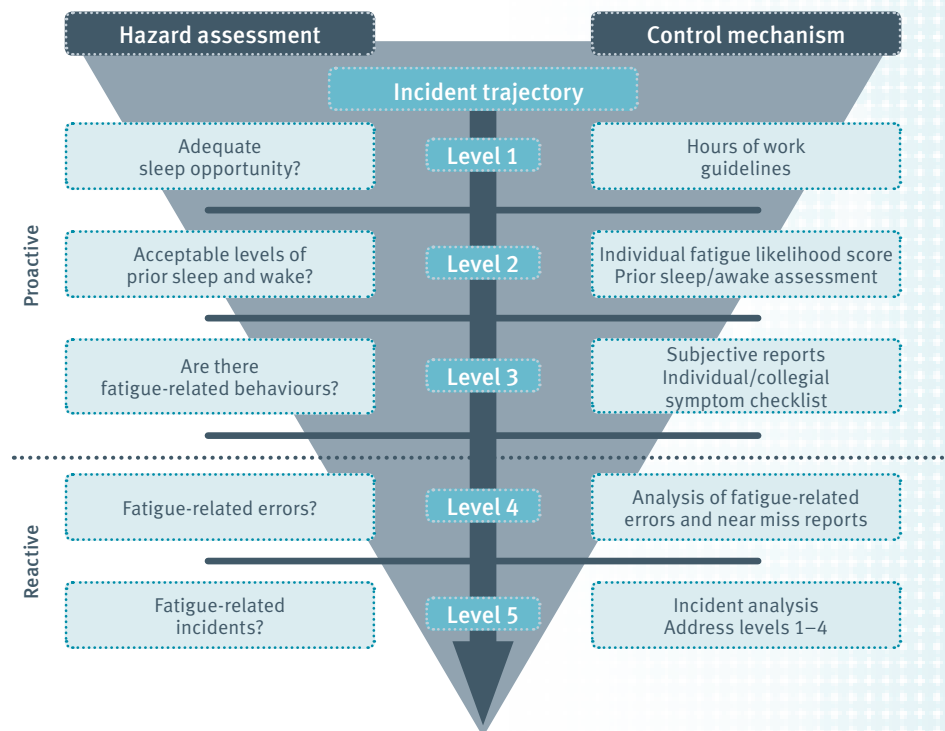
Broadly, an FRMS incorporates:

FRMS document The FRMS document defines and details the way that fatigue-related risk is dealt with in the organisation and is essentially the written version of the FRMS. The FRMS document will be similar to some of your hospital's other human resources and OHS documents in that it directs responses to a specific risk.

Risk mitigation strategies Defences in Depth framework (see figure below), this forms the major practical or day-to-day aspect of the FRMS and includes tools, strategies and control measures for monitoring and managing fatigue-related risk.

Education program All employees need to be made aware of the risks posed by fatigue in the organisation, and the individual and organisational strategies that are employed in managing that risk.

Audit function The system must be monitored for continuous improvement and to ensure it is flexible to change with changing work practices or functions. The audit function is essentially built into the Defences in Depth framework.



Source: Centre for Sleep Research, University of South Australia

Defences in Depth framework

The Defences in Depth framework is discussed in more detail in Section III. Briefly however, the framework provides multiple layers of defence against the occurrence of a fatigue-related incident. It's not only about work hours.

Why use an FRMS?

In the past, fatigue management has primarily involved prescriptive rules about working hours. Within such a framework there is an inherent assumption that if you follow the rules you will be 'safe'. This is clearly not always the case. For example, there are many reasons why an individual may not achieve adequate sleep. They may choose to sacrifice sleep for other activities such as family, social, leisure, etc. Alternatively, sleep may be disturbed because of illness (of self or others), noise, temperature, etc. Thus, although an adequate opportunity is provided by the working time arrangement, there is no guarantee that sleep will be obtained, and importantly, no capacity in the system to detect or act on inadequate sleep.

Further, situations occur when sleep may have been obtained in the sleep opportunity, but due to time of day, or workload for example, fatigue-related behaviours can occur. At 3:00am fatigue levels are naturally higher due to circadian influences. If work hours are the only risk mitigation strategy there is no capacity in the system to detect other precursor events or signs that a fatigue-related incident may occur.

An FRMS provides several layers of defence against fatigue-related risk. A risk management approach provides for tailoring of an FRMS in an industry in which a one-size-fits-all solution is not viable. Queensland Health is one of the most decentralised health services in Australia, requiring flexibility rather than prescription. On a daily basis, doctors are performing risk assessments with regard to their clinical decisions. It is likely that doctors also make judgements about their ability to perform a task, taking into account their current level of impairment (if any), the consequences of not acting, and the likelihood of something going wrong. These decisions will be supported by an FRMS through the use of objective thresholds that will be determined based on the local environment.

For further reading see Dawson and McCulloch (2005) listed in the References section (page 88).¹

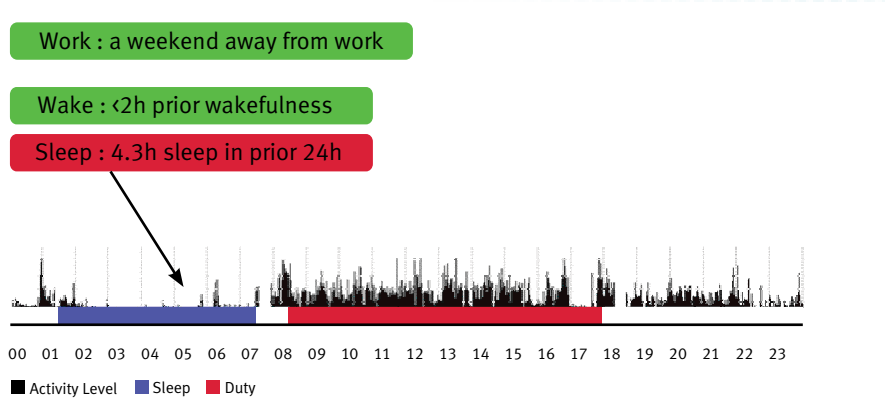
FRMS philosophy – relative risk in healthcare settings

An FRMS acknowledges that fatigue management in healthcare is not as simple as working fewer hours, or just declaring yourself 'not fit for duty' when you have worked in excess of a set threshold. One key philosophy of an FRMS has been articulated as:

**The risk of withdrawing a medical-related service
must not exceed the risk of
a fatigue-related error occurring.**

One of the more controversial arguments made is that sometimes a tired doctor may be better than no doctor at all. This is trying to convey the concept of relative risk. For instance, the risk of not providing care to a patient requiring an emergency caesarean at 4:00am in the morning might well outweigh the risk of making a fatigue-related error.

Much can be done to 'tactically' manage fatigue. Tactical fatigue risk management requires developing a flexible work system that can respond to instances of fatigue when they arise on a day-to-day basis. Thus, while much of the FRMS is designed to reduce the likelihood of fatigue occurring, other components of the FRMS focus on minimising the risk when fatigue does occur. Fatigue must be seen as a natural part of the human condition, and as such can never be completely eliminated. A well designed FRMS will reduce the occurrence of fatigue and effectively manage fatigue risk when it occurs.

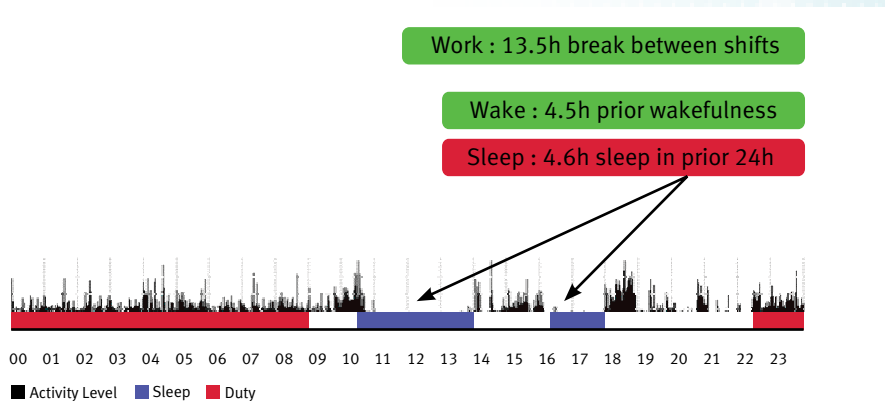


This figure illustrates sleep/wake data collected by an individual doctor at one of the case study sites.

The roster provided a weekend away from work. Using work hours as the only measure (Level 1 control in the Defences in Depth framework), fatigue-related risk would be deemed acceptable and no risk mitigation controls would be actioned.

However, an assessment of the actual sleep obtained (Level 2 control the Defences in Depth framework) demonstrates that the amount of sleep that the doctor obtained in the 24-hour period prior to work beginning was less than five hours. Five hours of sleep is associated with increased risk of impairment.

Without an assessment of risk associated with actual sleep, the inadequate sleep would not be detected and controls would not be actioned.



This figure illustrates sleep/wake data collected by an individual doctor at one of the case study sites.

The roster provided a 13.5-hour sleep opportunity in between work periods. Using Level 1 assessment and controls only (work hours) fatigue-related risk would be deemed acceptable and no risk mitigation controls would be actioned.

However, a Level 2 assessment demonstrates that the amount of actual sleep obtained in the 24-hour period prior to work beginning was less than five hours. Five hours of sleep is associated with increased risk of impairment.

Without an assessment of risk at Level 2, the inadequate sleep would not be detected and controls would not be actioned.

What is this really going to take?

There are some key factors that are critical to the successful development and implementation of a tailored FRMS. These are:

- senior management commitment and support
- a Local Working Group (LWG) with representation from all departments/divisions
- local champions
- project officers in support of the LWG/departments/divisions
- district level content experts.

The work done with the case study sites demonstrated very clearly that having these components in place maximises the productive use of time of already busy medical officers whose input is essential throughout the whole process.

The LWG, supported by the Executive Director of Medical Services (EDMS) or Director of Medical Services (DMS), oversees the implementation process and subsequently will review FRMS reports and direct and support resultant actions. Together with the LWG, the Local Champions' role is to inform and advise people about the FRMS, and encourage the necessary changes required to move towards a culture of fatigue risk management by all parties. Project officers or administrative support is important in pulling together the document, but in most cases this needs to be done in conjunction with other Local Champions or clinical directors (or proxies).

From the outset, it is important that the organisation create and foster a culture in which it is OK for a doctor to put up their hand and say 'I haven't had enough sleep to do this safely' or, 'I am having trouble concentrating on this task'.

There are countless arguments against the implementation of fatigue management strategies and none of them justify a lack of action on patient or occupational health and safety grounds. Some common ones are listed in the following breakout box.

The common excuses for not taking action on fatigue risk management

All of these statements have arisen during one or more conversations during the Alert Doctors Strategy FRMS project. Whilst many of these highlight legitimate issues, none warrant inaction.

- The trainees won't get enough exposure to cases.
- Continuity of care will be affected.
- I did it this way.
- There's no-one else to do the work.
- You have to be able to function under pressure – including sleep deprivation.
- I don't need much sleep.
- We work shifts, there isn't a fatigue issue.
- This won't change anything.
- We don't know what they do away from here.

When the conversations are taken further, none of these barriers is deemed to be reason enough to not take action to manage the day-to-day fatigue-related risk in a facility.

A workshop conducted with Medical Superintendents additionally brought a range of site-specific issues to the fore, but again, all in the room were in agreement that these challenges should not prevent action on the ground to safeguard doctor and patient health and well-being.

Many of the case study sites were still able to implement FRMS controls after taking these issues into consideration.

Section I

Governance structures

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Roles and responsibilities

An initial step in the process of implementing an FRMS is to determine the governance structure by which the FRMS will be administered and to stipulate the key roles and responsibilities in your FRMS document.

The Queensland Health Medical Fatigue Risk Management Policy (below abbreviated to the Policy) defines the responsibilities to various individuals. These include the Director-General, Executive Management Team, District Chief Executive Officer/District Manager, EDMS or DMS, clinical directors of departments, the Fatigue Local Working Group (LWG), and individual medical officers. Responsibilities are listed below in brief but you should refer to the Policy.

Director-General

The Director-General will support the implementation and maintenance of FRMS in Queensland Health. The responsibilities of the Director-General in this capacity are to:

- Ensure the observance of the Policy
- Advise government of barriers preventing extreme and major level risks being managed to as low as reasonably practicable
- Prioritise allocation of available resources to reduce high-risk fatigue to as low as reasonably practicable (delegated to Deputy Director-General Policy, Planning and Resourcing).

District Chief Executive Officer

- Monitor district compliance with Policy
- Ensure risk control measures are appropriate for ongoing extreme and major level risk situations in accordance with the Queensland Health Integrated Risk Management Policy
- Prioritise allocation/reallocation of resources to reduce extreme and major level risk fatigue
- Advise Director-General of barriers preventing extreme and major level risks being managed.

Line Manager/Supervisor (EDMS, DMS, MSRPP, Clinical Director, most senior relevant clinician)

- Ensure FRMS meets all requirements of the Policy
- Ensure compliance with FRMS by medical staff and relevant clinical staff under their supervision
- Respond appropriately to reports of fatigue-related incidents, errors or behaviours
- Ensure training for self and direct reports required by FRMS is completed
- Where organisational delegations permit, ensure available resources are allocated in a manner that reduces fatigue-related risk to as low as reasonably practicable
- Advise supervisor of barriers preventing extreme and major level risks being managed.

Medical Officers (individual doctors)

- Present at work in a fit state to conduct duties safely
- Complete all training required by FRMS
- Identify, report and respond to actual and potential risks associated with fatigue according to the FRMS
- Inform the appropriate individual where adequate sleep has not been obtained
- Declare any work hours outside of rostered work at primary place of employment where it would elevate the risk of fatigue above that which would otherwise be expected.

Patient Safety, Workplace Health and Safety and Shared Services also have roles and responsibilities under the Policy.

An important component of your FRMS governance structure will be the Fatigue Local Working Group.

Fatigue Local Working Group (LWG)

The LWG will be the committee with responsibility for overseeing the monitoring and management of fatigue-related risk in the hospital. The LWG will also play a vital role in the creation and fostering of a culture in which fatigue risk management is well received and adopted as the norm in the workplace. Within this brief the LWG will:

- report directly to the EDMS
- liaise with patient safety committees or other OHS committees where they exist to ensure consistency between procedures
- design, tailor and implement an FRMS
- ensure all relevant employees complete appropriate training in fatigue risk management
- continue to review, monitor and improve fatigue risk management practices in response to changing operational needs and feedback.

Appendix 2 contains specific details about the LWG, including Terms of Reference and examples of typical meeting agendas.

In smaller sites, a stand-alone LWG is often not required. Instead, fatigue risk management can be included as a standing item on the agenda of another relevant committee – for example, the OHS or patient safety committee, or the management committee.

There are a number of different ways to convene LWGs. Some examples from the case study sites are provided below.

A medium sized hospital with some speciality services had not formally discussed fatigue risk management issues prior to the case study process beginning. The DMS convened a Local Working Group that included a project officer who was also the patient safety officer, several medical staff and administrative support. The LWG initially met fortnightly but the frequency of the meetings was reduced to monthly as the workload lessened. The Local Working Group initially assessed planned and actual hours worked by medical officers and also reviewed work practices as a starting point for their activities.

A regional facility made the decision to include fatigue risk management as a standing item on the agenda of the clinical governance committee. The committee included medical officers, allied health and nursing staff, patient safety and OHS officers.

All of the smaller sites that participated as case studies simply added fatigue risk management to agendas of other regular meetings. A major component of risk management in small sites is the team aspect and thus nursing and allied health staff are critical in the successful implementation and action of the fatigue risk management system.

Key tasks: Governance structure

These are the key tasks relating to the establishment of an appropriate governance structure for your FRMS:

- Liaise with the District Chief Executive Officer/District Manager on district resources and project support.
 - Establish top-level management commitment across the facility.
 - Identify a project officer and Local Champions.
 - Decide on the most appropriate format for your Local Working Group.
 - Convene the Local Working Group.
-

Section II

Conduct a fatigue risk scan

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What is our fatigue-related risk?

As fatigue is a risk to be considered for any organisation providing round-the-clock service, the real question pertains to the degree of risk that is acceptable with relation to fatigue. In order to determine this, a number of questions need to be initially addressed to determine current fatigue-related risk.

Where is our fatigue-related risk highest?

When does it impact?

Who does it impact?

How does it impact?

A fatigue risk scan will identify the specific occurrences of fatigue-related risk in an individual unit or facility. The fatigue risk scan requires a group of people with current knowledge about the working environment. Other individuals that could contribute to this process include your OHS officer, a patient safety officer, and personnel with risk management expertise. Specifically, the questions that should be addressed in some detail are:

- When is fatigue-related risk increased for us? When in the roster or the day or the week or the year is risk increased?
- When fatigue-related risk is increased, who is it impacting? Is there a specific group of doctors within the hospital/department that are at increased risk due to the nature of their work arrangements?
- How does the increased risk impact? What tasks are susceptible to fatigue? How does performance change? Is the patient or doctor at risk or both?

Other questions, based on the Defences in Depth framework, might include:

- To inform our assessment, what information do we have about hours of work, actual sleep, time awake, fatigue reports, etc?
- Do we need to collect some more information or data about these factors (see Appendix 5)?
- What is the information telling us?
- What do we need to do differently (eg. work practices)?
- Can we do things differently?
- What prevents/restricts us from changing things and are these reasonable barriers?

Case study: Fatigue scan with whole department

Once a month, directly after the daily morning handover, the unit director leads a discussion about fatigue.

This regular discussion makes sure fatigue is constantly 'on the radar' and any fatigue risks are regularly identified.

After several such discussions, the areas of high fatigue risk were easily identified, and the unit developed an agreed set of controls to form the basis of the unit's FRMS.

Subsequent meetings enabled the existing controls to be reviewed and any new areas of fatigue risk to be quickly identified.

Case study: Fatigue scan with individuals

In one busy department, it was difficult to get everybody in the same place due to rotating shifts being worked. Also, the director was concerned that the large number of junior doctors and international medical graduates might not be comfortable speaking up on topics they were concerned about.

To overcome these limitations, the unit director asked the patient safety team to run a series of informal and anonymous discussions with junior doctors about fatigue. This process highlighted a number of fatigue risks, including the fact that junior doctors were not comfortable asking to be relieved from duty after busy on-call nights in the hospital.

This came as a surprise to the unit director, who had repeatedly emphasised that he wanted junior doctors to take fatigue leave when appropriate. The unit developed an FRMS which emphasised the shared responsibility for fatigue and set objective thresholds for fatigue leave and task reallocation after busy on-call periods.

How are we currently managing our fatigue-related risk?

Based on the answers that identify the fatigue-related risks, a decision needs to be made about whether or not the identified risks are currently being managed adequately. That is, where fatigue-related risk is elevated, is it an acceptable risk based on everything we know? This requires you to identify all the current controls that are in place. Appendix 3 contains detailed guidance about developing a fatigue risk register.

It should be noted that the fatigue risk scan and subsequent risk register, will form a very strong foundation for your FRMS through the identification of current and potential controls. It is also important to understand that the vast majority of controls that are in place in your facility/department are most likely informal controls. Indeed, these controls are probably not called controls and almost certainly aren't presently referred to as fatigue risk management strategies.

The big question when assessing your fatigue-related risk is:

**Can we put our hands on our hearts
and say we are currently doing everything
reasonably practicable to manage this risk?**

Key tasks: Fatigue risk scan

These are the key tasks relating to the fatigue risk scan.

- Discuss the fatigue risk scan format and timelines at the Local Working Group.
 - Assign roles and responsibilities for conducting and writing up the results of the fatigue risk scan.
 - Choose the most appropriate format for the fatigue risk scan – either individual interviews, focus groups or a written survey.
 - Conduct the fatigue risk scan.
 - Identify the specific fatigue-related risks and develop a fatigue risk register.
 - Evaluate the current risk mitigation strategies and develop the action-plan for the FRMS.
-

Section III

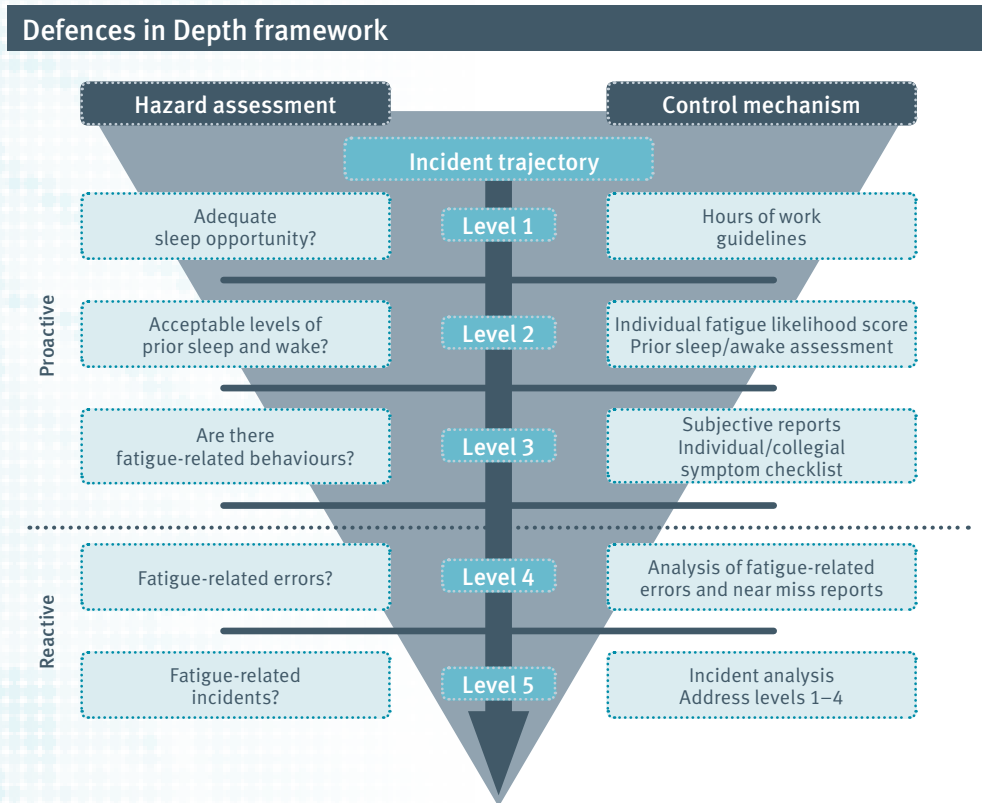
Defences in Depth

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Defences in Depth

The Defences in Depth section forms the major practical, or day-to-day, aspect of the FRMS. This is the part that most employees will be exposed to most frequently.

Defences in Depth requires the most input in terms of tailoring to ensure local risk is managed through locally-appropriate solutions. The tools and controls that are highlighted here can be applied in a multitude of situations and organisations, but it is the way that they are applied and used that ensures they work in the local setting.



Source: Centre for Sleep Research, University of South Australia

The FRMS framework has been introduced to you and scientific evidence supporting the use of each level of control is provided in Appendix 5. The framework is based on James Reason's incident trajectory.

The logic behind the Defences in Depth framework follows the trajectory of a fatigue-related incident. For a fatigue-related incident to happen, a fatigue-related error must be made. In turn, if an error is committed, the individual would have been exhibiting some signs or symptoms of fatigue, or fatigue-related behaviours. To be exhibiting signs of fatigue, an individual will have had insufficient sleep leading up to that point (which may be associated with inadequate sleep prior to starting a shift or extended time awake, both of which can be exacerbated by circadian factors). And finally, if an individual has been awake too long or has obtained insufficient sleep, then the sleep opportunity may not have been adequate.

At each level there are opportunities to put in place control strategies to manage the fatigue-related risk. Defences in Depth represents the major risk mitigation strategies employed by an organisation with respect to fatigue.

The information you gathered during the fatigue risk scan will directly inform the assessment and control strategies in your FRMS. You may want to revisit these questions.

At each level in the incident trajectory, a series of questions can be asked. These include:

- To inform our assessment, what information do we have about hours of work, actual sleep, time awake, fatigue reports, etc?
- Do we need to collect some more information or data about these factors (see Appendix 5)?
- What is the information telling us?
- What do we need to do differently (eg. work practices)?
- Can we do things differently?
- What prevents/restricts us from changing things and are these reasonable barriers?

In most facilities there are countless practices, procedures, strategies and habits the organisation, or individual departments already do that will fit directly into the FRMS. While these may not necessarily be acknowledged as formal fatigue risk management strategies at present, they will likely form a major part of the Defences in Depth framework. Answering the questions above for each level in the Defences in Depth framework will ensure you are not reinventing the wheel. Some of these questions will be answered in the fatigue risk scan but some will require further discussion and testing in the workplace.

Think of the Defences in Depth framework like this.

You assess the fatigue-related risks to be extreme for a specific group of doctors in the hospital, let's say the Resident Medical Officers on ward call overnight. Now, this extreme risk exists in the absence of any mitigating controls designed to reduce the fatigue-related risk for this group. As you work through the fatigue risk scan you will identify things that are already in place to manage the risk and where those things are inadequate or require supplementation.

Examples might include:

- the ability to call a registrar or consultant if in doubt about a decision
- they might be able to have a nap during the shift
- the number of consecutive nights may be restricted to reduce the chance of a sleep debt accruing
- a minimum amount of sleep during the day may be required before they can start work.

Each of these measures reduces the risk of a fatigue-related incident occurring, and they each act at different points in the Defences in Depth framework.

The goal is to set trigger points, based in scientific evidence and in your fatigue risk assessment, on which control strategies are implemented.

Your Challenge

How flexible/lateral thinking can we be?

Throughout this process the challenge will be to think outside the square when looking for solutions and when thinking about the working time arrangements and the way work is done in your facility. A major issue in fatigue management is one of culture, and that is the case in all industries. While the culture of an industry or even an organisation cannot be changed overnight, discussions around specific targets (short- and long-term) can begin to move ideas forward.

As an example, current practice in hospitals is under review with such initiatives as the Hospital at Night program in the United Kingdom, and lean thinking strategies now being applied in healthcare. Both of these concepts are perfectly amenable with FRMS.

Ultimately you will determine thresholds for action for each level in the Defences in Depth framework. When these thresholds are reached, tailored action plans are initiated to manage the increased risk. As an example, thresholds for a Level 1 control (consecutive work hours) may exist at 12, 14 and 16 hours and as each threshold is reached, specific actions are triggered as a result. Importantly, a large number of strategies are probably employed in your hospital already. Your task now is to document these and promote their use within the FRMS framework.

How do we determine our thresholds?

The thresholds are based on scientific evidence about sleep, wake, work hours, performance changes, error and incident frequency. A summary of this information is provided in Appendix 5 together with a resource list of journal articles for further reference in the References Section (page 88).

The thresholds provided may not necessarily be appropriate for your speciality or hospital or team. Whatever thresholds you use need to be based on your assessment of local fatigue-related risk, including current controls.

What do we do with our thresholds?

Based on your fatigue risk scan, controls that you have in place and controls that you plan to put in place, and the information provided in the section above, you will define thresholds for action at each level in the Defences in Depth structure.

In the next part of this section, a series of action tables are provided as templates with thresholds for each item. The thresholds are based on the science as discussed previously and when the thresholds are reached, a series of locally-determined actions are triggered. The actions (or controls) are examples only, document your own actions/controls based on the level of risk and your specific risk management strategies. What works in one hospital may not be appropriate in another hospital. Indeed, different departments in the same hospital will need very distinct controls.

The following action tables are presented in this way:

Hazard assessment item	Risk level	Controls
<X	Low	A ...
X–Y	Moderate	A and B...
Y–Z	High	A and B and C...
Z+	Very high	No work where possible. If essential, Controls A–F.

The hazard assessment item will be the shift length, actual sleep, an individual fatigue likelihood score, etc. The risk level will be determined based on the local fatigue risk assessment. In the action table example, X, Y and Z represent the specific thresholds (eg. X = 10 hours for shift length).

As an example, the above table might apply to a heavy vehicle driver where anything over Z means a very high level of risk. In contrast, an individual working at a desk, without a driving task may be able to operate perfectly safely at a level of Z and therefore the risk would be acceptable or minor. The level of risk may equally be very different for a mental health department compared to an orthopaedics unit (not implying which group carries the higher risk).

As part of the control strategies, there needs to be a reporting structure that advises when thresholds are reached. This should follow normal reporting structures for other OHS and clinical governance matters and should include reports to the facility's LWG. This feedback and reporting loop allows the system to be continuously monitored and improved upon. The schematic on the following page shows how reports from each level inform the continuous improvement of the whole system. As an example, if 10 per cent of shifts in a month are associated with reports of inadequate sleep at the start of shift, the Level 1 controls need to be reviewed to ensure adequate sleep opportunity is actually being provided.

Level 1: Working time arrangements and sleep opportunity

Critical question: Do the working time arrangements provide sufficient sleep opportunity for recovery and not have people awake for too long?

To minimise the likelihood of fatigue, the design of working arrangements needs to provide an adequate opportunity for sleep and avoid people being awake for excessive lengths of time. There are a number of ways to ensure employees are provided with sufficient sleep opportunity within their schedule. You may choose to use one or a combination of these methods for designing rosters and keeping track of hours of work. Remember that the critical factors are sleep opportunity and time awake, but you should also take into consideration the time of day the work is being done. This can be built into the local controls and be accounted for by varying thresholds according to the risk.

The tools that can be used to assist in the design of schedules include:

- locally or centrally determined hours of work guidelines
- a computer-based fatigue modelling package (FAID) (Appendix 7)
- a fatigue-likelihood matrix such as provided by the Australian Medical Association (AMA)*.

Hours of work guidelines can be used to provide general guidance for developing a schedule. Computer-based modelling software allows you to get an overview of the potential fatigue hotspots in your roster. A fatigue likelihood matrix also provides a general overview of the roster from a fatigue perspective, using a number of metrics known to increase fatigue-related risk. Regardless of the tool that is used, it must suit the context of the department or hospital. For example, rigid application of tools may not be appropriate in situations where it could negatively impact on other factors, such as medical training and workforce retention.

When reviewing hours of work, it is important to assess planned hours (ie. the roster) and also actual hours. Actual hours should be reviewed periodically to ensure what is actually happening either matches what is planned and/or that thresholds aren't being breached beyond accepted limits. Actual hours will be used to assess risk on a daily basis, but violations also need to be viewed in the big picture.

Level 1 in the FRMS is concerned with **planning work hours** to minimise fatigue-related risk and **reviewing actual work hours** to initiate fatigue risk management strategies as necessary. To this end, a number of important questions need to be answered at Level 1.

First, how are the working time arrangements designed and what are the local thresholds that trigger fatigue risk mitigation actions in the roster design phase?

Second, how are the inevitable changes to a roster managed on a day-to-day basis and what are the local thresholds that trigger fatigue risk mitigation actions when a shift is swapped or extended?

Third, what are the specific risk-mitigation actions that are triggered, both in the roster design phase and in the management of actual hours worked on a day-to-day basis?

Also, how do we deal with the more dynamic components of healthcare work design, such as on-call hours and recalls?

* The AMA guidelines are a Level 1 control that provide an assessment of the fatigue-related risk inherent in a roster arrangement. As with other Level 1 controls, they should be used in conjunction with other controls and also applied in the context of the local situation. The AMA guidelines are not an alternative to FRMS but sit very well within the FRMS framework.

Finally, it is important to remember that:

- fatigue-related risk increases with increasing shift length, due to time awake and time on task
- the amount of sleep obtained between shifts is heavily dependant on the length and timing of breaks from work
- your thresholds will need to adhere to awards, certified agreement requirements, Queensland Health policy, etc.

In designing rosters or managing working time arrangements, there are a number of factors to consider: shift length, number of consecutive shifts before short breaks (1 to 2 days), time off between shifts, amount of night work and frequency of breaks longer than 2 days. Each of these factors is known to influence fatigue-related risk in the context of accumulation of fatigue or recovery from fatigue.

The Fatigue Audit InterDyne (FAID) program takes into account each of these factors. It is therefore a useful tool in developing and assessing the fatigue-related risk inherent in rosters. Length of shifts and time away from work are also simple metrics that assist in assessing and managing fatigue-related risk, and can be easily used on a day-to-day basis.

The following part of this section is divided into three sub-parts:

- planned or rostered hours (not on-call)
- actual hours (not on-call)
- on-call hours.

On-call hours are discussed particularly as this working time arrangement has unique characteristics that cannot always be accounted for in the following action tables/templates.

Planned or rostered hours (not on-call)

When setting thresholds and controls for planned or rostered hours, a number of factors can be taken into account. These include shift length, time away from work and various shift patterns, such as consecutive nights or early starts.

Thresholds for **rostered length of shift** and **rostered time off** are provided in the following two action tables. Based on the specific risk assessment for your unit/facility, adjust the thresholds and document your own controls for both. Detailed examples of controls, at each level of fatigue risk, are provided in Appendix 8.

Example 1.1: Rostered length of shift

Length of shift	Risk level	Controls
<10 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
10–12 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
12–16 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
>16 hours	Very high	Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

Example 1.2: Rostered time off

Time off	Risk level	Controls
>12 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
10–12 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
8–10 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
<8 hours	Very high	Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

How do/will you monitor this to ensure people work under green and yellow conditions?

There will need to be a method to ensure the roster is designed in a way to meet the thresholds set by your unit/facility. The FRMS may outline the number of shifts that can be scheduled in the green, yellow and red bands, and the person responsible for the roster should adhere to this. For example, you may decide that your facility has a target of less than 10 per cent of all shifts to be scheduled in the orange band in each calendar month and that more than 60 per cent should be in the green band. This takes into account that in some situations, for reasons of patient outcomes, work needs to be extended beyond the otherwise agreed limits.

While there are ways of managing the risks associated with individuals working in the 'red zone', there remains a requirement within the FRMS to manage the work hours so that adequate sleep opportunity is provided.

Actual hours (not on-call)

The other portion of your FRMS strategies at Level 1 will focus on actual hours. This will involve constant monitoring of the hours that people are working on any given day and allows risk to be assessed and managed immediately.

Thresholds for actual length of shift and actual time off are provided in the following two action tables. Based on the specific risk assessment for your unit/facility, adjust the thresholds and document your own controls for both. While there is a requirement in the FRMS not to roster anyone in the very high risk category, there will possibly be times when work periods will extend past 16 hours for operational reasons.

Example 1.3: Actual length of shift

Length of shift	Risk level	Controls
<10 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
10–12 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
12–16 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
>16 hours	Very high	Intolerable risk. No individual to work beyond this threshold unless risk to patient is unacceptable. <ul style="list-style-type: none"> • Make a decision with unit director • Report occurrence on fatigue report form • Initiate very high fatigue risk mitigation actions.

Example 1.4: Actual time off

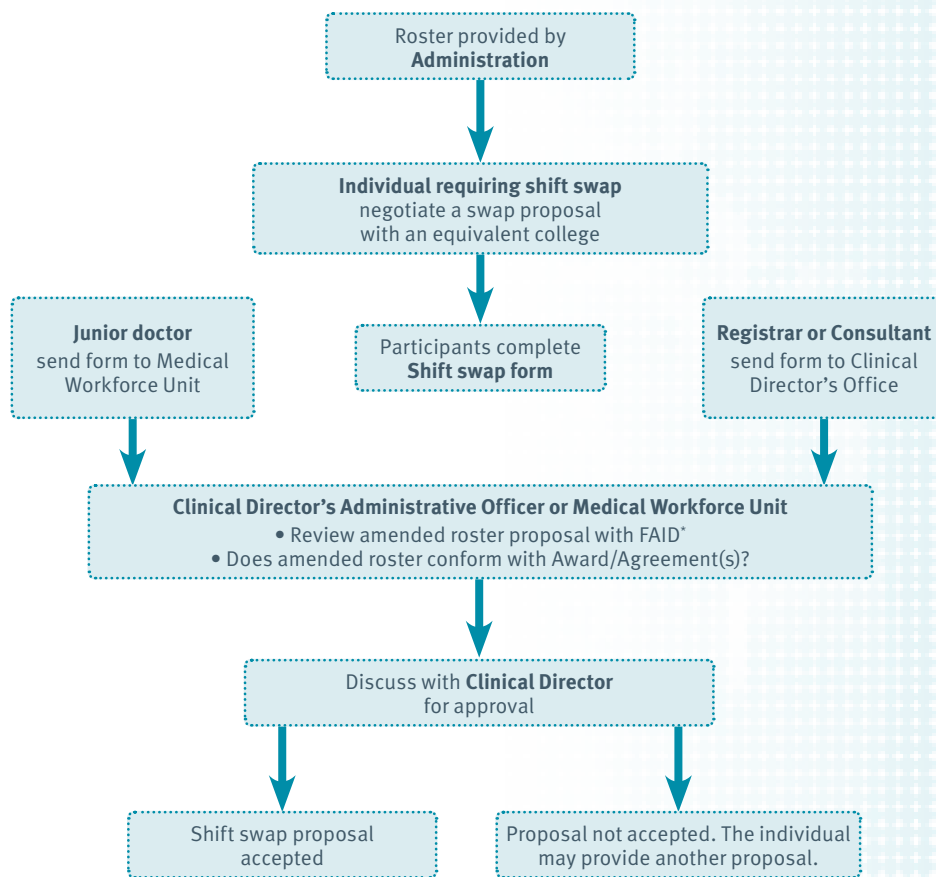
Time off	Risk level	Controls
<12 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
10–12 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
8–10 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
>8 hours	Very high	Intolerable risk. No individual to work beyond this threshold unless risk to patient is unacceptable. <ul style="list-style-type: none"> • Make a decision with unit director • Report occurrence on fatigue report form • Initiate very high fatigue risk mitigation actions.

Shift swaps

While the initial roster design might minimise fatigue-related risk, informal shift swapping between members of a team has the potential to inadvertently increase fatigue-related risk significantly. To this end, each unit should develop a formal process to manage and approve shift swaps.

Below is an example of a shift swapping pathway designed to track changes to planned shifts and ensure that approval for shift changes is based on the fatigue risk management framework. *The specific pathway that your hospital or department adopts will need to be determined locally, as this is a specific example from one particular FRMS.*

Case study: Shift swapping pathway



On-call rosters

On-call rosters present a unique set of challenges. It is obvious looking at the previous action tables that setting similar thresholds for rostered on-call periods is not realistic. Doctors are routinely rostered for on-call periods of 24 hours and sometimes across an entire weekend. Therefore, the Level 1 controls associated with rostered on-call work needs to firstly focus on the frequency of on-call periods. Based on staffing levels and service requirements, the frequency of on-call periods needs to be managed to provide adequate recovery sleep opportunities. Other Level 1 or rostering controls may include no day shift following night on-call.

Actual hours can be used as a Level 1 assessment and control method as outlined in the previous action tables.

For on-call work then, Level 2 assessment plays a critical role in risk management, as the workload of individual on-call periods may well vary significantly.

Case study rural/remote site – Extract from FRMS: On-call controls

All work between midnight and 6am should be considered high to very high risk and in all circumstances:

- shift to be documented in fatigue diary
- work to cease as soon as possible.

Increased awareness of fatigue signs and symptoms by nursing staff which may involve, but are not limited to:

- routine double-checking/repeating of directions and medications
- reduction of workload and degree of sleep interruption where applicable (doctor not to be called for category four and five patients)
- night ward staff to notify day staff at handover that doctor is not presenting until they have had eight hours away, and that fatigued doctor will contact colleagues in office hours when awake or can be contacted only if emergency issues to be addressed.

Doctor to consider:

- assistance with cover (firstly from other SMOs and GPs as a second option)
- use of video conferencing as option for technical advice
- reallocation of patients to neighbouring facility (dependent on resources and time of week)
- a written handover for the next morning to provide longer sleep opportunity.

Example 1.5: Consecutive on-call shifts

Consecutive on-call shifts	Risk level	Controls
<2	Acceptable	<p>There are no immediate controls at this level except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents)</p> <ul style="list-style-type: none"> • Mandatory assessment of Level 2 and 3 at beginning of all call-in shifts.
2 or 3	Minor	<p>Mandatory assessment of Level 2 and 3 at beginning of all call-in shifts.</p>
4	High	<p>Mandatory assessment of Level 2 and 3 at beginning of all call-in shifts.</p> <p>Request another Doctor to cover a portion of the shift:</p> <ul style="list-style-type: none"> • another SMO • Private GP, if the private GP is then in turn fatigued for their next day shift, the public doctor can suggest diverting any new patients to the hospital if the GP's day is completely booked.
>4	Very high	<p>No individual will be rostered for more than four consecutive on-call nights. Relief sought from private GPs .</p>

Case study: Large hospital – on-call controls

On-call risk management

Managing the fatigue risk associated with on-call shifts is one of the hardest components of the FRMS. On-call is by its nature, dynamic and unpredictable. To this end, Level 2 and 3 controls (which will be discussed shortly) may be the best strategy for risk management. However, several large hospitals developed Level 1 principles for managing the fatigue risk associated with on-call work. Two examples are provided below.

On-call shifts (Registrars and PHOs)

- An agreement will be drafted between the Emergency Department and in-patient units dictating calls to Registrars/Principal House Officers after hours.
- Ward guidelines will be drafted for contacting the medical officer on-call for surgery.
- Fatigue Leave should be taken, wherever possible, following on-call shifts by utilising the fourth Registrar/PHO for task re-allocation until the Medical Officer has completed an eight-hour break. Where this does not occur, a Medical Officer Fatigue Report Form must be completed.

On-call shifts (Consultants)

Consultants/Senior Medical Officers should be provided with a rostered day off following on-call overnight shifts. Where this is not possible:

- 'quiet' time should be provided the following morning
- for example, there should be no rostered theatre commitments the following morning and where clinic attendance is necessary, the Medical Officer should be in a supernumerary role
- where this is not possible, the Medical Officer should work with the most experienced rostered junior medical officer

Case study: On-call versus rostered shifts

A question that came up frequently in the case study process was in reference to on-call versus rostered shifts and the point at which one is better (from a fatigue risk management perspective) than the other. As with most roster-related questions, the answer is 'it depends' and it will be more a question for larger sites than small sites.

Workload is one factor that will assist in determining whether rostered shifts are preferable to on-call shifts.

- Does the doctor have opportunity for sleep during the on-call period?
- What controls might be put in place for situations where a doctor does have a busy night but is scheduled to work the following morning?
- Are there options for an evening shift cover?

These questions really need to be asked and answered locally. A Director of Medical Services from a small to medium sized site described their trial of an evening shift cover to manage workload and fatigue-related risk. However, the result was reduced flexibility in the number and skill mix of doctors available at all hours and a perception of increased fatigue across the board.

In facilities where there was a sufficient number of doctors with the correct mix of skills, a second on-call person has been implemented as a fatigue risk management control.

FAID – Biomathematical modelling of fatigue-related risk

An alternative, or supplementary Level 1 assessment is to use the biomathematical modelling software, FAID. Rosters can be entered into FAID prior to the work being undertaken to provide a prospective analysis and to check that risk is acceptable. Alternatively, actual hours can be entered to provide a retrospective analysis.

To interpret FAID assessments, you will need to determine:

- what are the local thresholds for FAID scores for planned and actual shifts?
- what happens when these thresholds are exceeded?

Things to remember are:

- the threshold FAID scores should be determined relative to the risk associated with the task
- a score of 40 is the maximum reached during a 9:00am to 5:00pm Monday to Friday work week. Aviation organisations use a threshold of 65-75 for flight crews.
- you can set thresholds for the percentage of shifts (or work periods) that can be scheduled with certain FAID scores.

Example 1.6: Actual length of shift

FAID score	Planned	Actual	Non-compliance action
<70	Not less than 95% of scheduled hours	Not less than 95% of hours worked	None, unless evidence of Level 2 or higher hazards are present.
70–80	Not more than 2.5% planned hours	Not more than 3.75% of actual hours	Investigate and undertake immediate corrective action where likelihood of re-occurrence.
80+	0%	1.25% of actual hours	Escalate to district management.

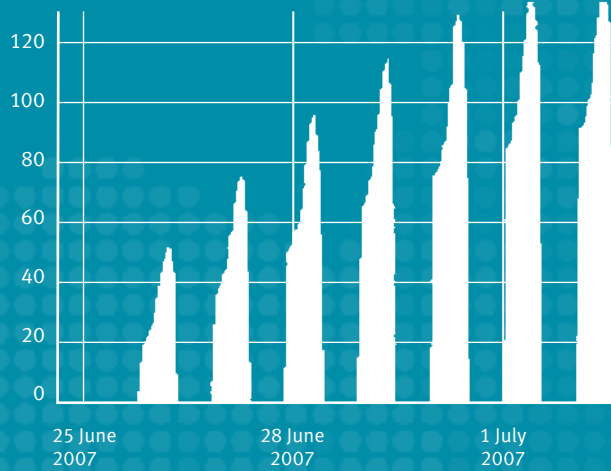
Case study: FAID

One case study site used FAID to review rosters in a department where a series of seven consecutive 12-hour night shifts were being worked.

The FAID model highlighted that after three consecutive night shifts the fatigue risk scores peaked at over 100.

As there was no evidence of other fatigue risk mitigation, such as the ability to sleep during the night shifts, a decision was made to change the roster.

Indicative fatigue plot



Key tasks: FRMS Level 1

These are the key tasks relating to Level 1 of the FRMS:

- Begin with the areas of high risk and areas in need of additional fatigue risk reduction identified through the fatigue risk scan process.
- Assign roles, responsibilities and timelines at the unit level for Level 1 FRMS development.
- Undertake a review of current working arrangements, including rostered hours, actual hours, shift swapping and on-call work.
- Consider utilising the FAID biomathematical model in the evaluation of current rosters and any proposed changes.
- Develop Level 1 FRMS core principles for the unit, that outline the overarching philosophy of fatigue risk management as it relates to hours of work.
- Determine thresholds for fatigue risk management and develop action tables describing specific Level 1 controls (Appendix 8 provides further examples and guidance).
- Identify key monitoring strategies for the FRMS.
- Submit draft Level 1 FRMS components to the unit and the facility Local Working Group for review.
- Document final components of FRMS and schedule review date.
- Undertake training for management and employees on new Level 1 controls.

Level 2: Individual wake and sleep on any given day

Critical question: Am I safe to work – have I had enough sleep recently, and have I not been awake for too long to be safe for myself, my colleagues and my patients?

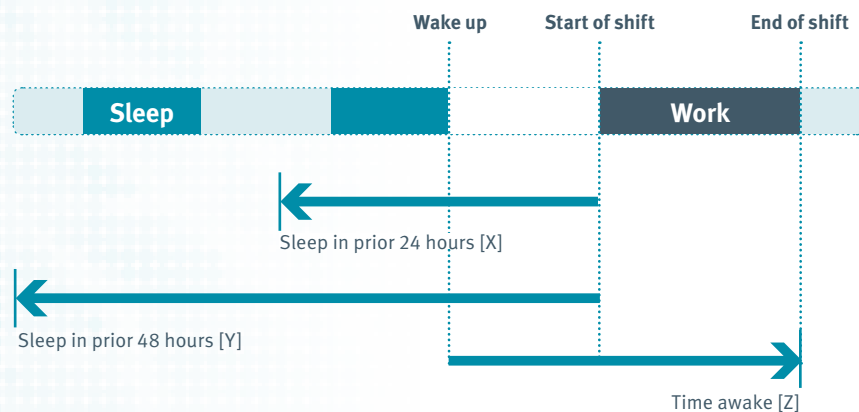
For Level 2 assessment and controls you will need to determine triggers and actions for actual prior sleep and prior wake.

Both sleep and wake are important determinants of fatigue-related risk and both need to be assessed and actions taken where thresholds are exceeded. Sleep in the prior 24-hour period is a critical factor in mediating fatigue-related risk and errors. Thus, assessing sleep will be a part of the Level 2 control. Similarly, the time awake (ie. time since the last sleep) is also an important factor.

To this end, fitness for work can be determined by an algorithm that is comprised of three simple calculations:

- (X) prior sleep in the prior 24 hours
- (Y) prior sleep in the prior 48 hours
- (Z) length of wakefulness from awakening to end of work.

Individual fatigue likelihood algorithm



Source: Centre for Sleep Research, University of South Australia

Another assessment tool combines both prior sleep and wake into an easy-to-use calculator which can be put onto a small reference card. This tool is used in other industries as a Level 2 assessment and control strategy, based on individual fatigue likelihood scores.

Following are example action plans for prior sleep, prior wake and the individual fatigue likelihood score calculator on which to base your tailored local action plans.

Example: Actual sleep action plan

What are the thresholds for minimum amount of sleep? What happens when these thresholds are reached?

Things to remember are:

- the amount of sleep people need does vary between individuals, but a minimum amount of sleep is required to maintain performance
- studies suggest that less than five hours of sleep in the prior 24-hour period is associated with detriments in performance and alertness.

Example 2.1: Actual sleep

Sleep in prior 24 hours	Risk level	Controls
+7 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
6–7 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> ● Level 2 and 3 assessment ● Individual controls
5–6 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> ● Document with unit director and/or EDMS ● Level 2 and 3 assessment ● Individual controls ● Team-based controls ● Support napping and safe-home policies
< 5 hours	Very high	Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

Example: Prior wake action plan

What are the thresholds for length of prior wake? What actions are required when prior wake extends past local thresholds?

Things to remember are:

- with increasing time awake fatigue-related risk also increases
- studies suggest that more than 16 hours of wakefulness is associated with decreases in performance and alertness.

Example 2.2: Length of wakefulness

Prior wake	Risk level	Controls
<12 hours	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
12–14 hours	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> Level 2 and 3 assessment Individual controls
14–16 hours	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> Document with unit director and/or EDMS Level 2 and 3 assessment Individual controls Team-based controls Support napping and safe-home policies
+16 hours	Very high	Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

How do/will you monitor that people are actually getting sleep prior to working?

Prior sleep and wake assessments may be required:

- at start of every work period
- when shift length is extended (according to Level 1 thresholds)
- on call-ins.

How many reports of doctors working in the red zone or yellow zone will trigger a reassessment of the roster or work practices?

Individual fatigue likelihood score calculator

This calculator assesses the amount of sleep an individual has had in the prior 24 and 48 hours, in addition to the length of time they have been awake.

There are three steps in the calculation process. In the example below, the doctor obtained four hours of sleep in the prior 24 hours, and seven hours of sleep in the 24 hours before that (which equals a total of 11 hours of sleep in the prior 48 hours). The assessment is being done at the end of a planned shift to determine risk associated with working overtime. It's currently 8:00pm and the doctor woke up at 6:00am. Thus the current wake time is 14 hours, which is three hours greater than the amount of sleep in the prior 48 hours.

Fatigue assessment					Score	
Step 1: Sleep in prior 24 hours					4	
Sleep	≤2 hours	3 hours	4 hours	≥5 hours		
Points	12	8	4	0		
Step 2: Sleep in prior 48 hours					2	
Sleep	≤8 hours	9 hours	10 hours	11 hours		≥12 hours
Points	8	6	4	2		0
Step 3: Prior wake					3	
Count the total hours you will have been awake at the end of your shift (excluding any anticipated sleep during the shift). For every hour more than your sleep in the prior 48 hours, add one point.						
Total points to determine your score					9	

45

What action do I take?	
Score	Control level
1–4	Fatigue risk – Moderate
5–8	Fatigue risk – High
9+	Fatigue risk – Very high

Refer to the departmental fatigue risk management guidelines for approved controls.

In this example, the individual fatigue likelihood score is 9, which puts the doctor in the red zone.

Example 2.3: Actual sleep		
Score	Risk level	Controls
1-4	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
5-7	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
7-8	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
+9	Very high	Go back to bed. Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

The FRMS recognises that there will be situations where fatigue-related risk is elevated, but the risk associated with not continuing work outweighs the risk of continuing, and work may occur in the >9 band. Both scenarios (ceasing work and continuing work) involve a series of controls that include reporting requirements

Key tasks: FRMS Level 2

These are the key tasks relating to Level 2 of the FRMS.

- Begin with the areas of high risk and areas in need of additional fatigue risk reduction identified through the fatigue risk scan process.
- Assign roles, responsibilities and timelines at the unit level for Level 2 FRMS development.
- Consider, where possible, undertaking a review of actual prior sleep and wake values for each type of shift.
- Develop Level 2 FRMS core principles for the unit.
- Determine thresholds for fatigue risk management and develop specific Level 2 controls (Appendix 8 provides further examples and guidance).
- Identify key monitoring strategies for the FRMS.
- Submit draft Level 2 FRMS components to the unit and the facility Local Working Group for review.
- Document final components of FRMS and schedule review date.
- Undertake training for management and employees on new Level 2 controls.

Level 3: Symptoms of fatigue

Critical question: Am I safe to work – Am I feeling okay or am I exhibiting symptoms of fatigue? Is my colleague exhibiting symptoms of fatigue?

Even though an individual's roster and sleep history might be OK, it is still possible that cumulative forms of fatigue can impair performance and give rise to elevated levels of fatigue-related risk.

Level 3 enables individuals and teams to identify the symptoms of fatigue and put in place risk management controls when an individual might be exhibiting symptoms of fatigue.

The Level 3 tools for self-assessment can be as simple as a subjective fatigue scale, and can trigger a range of controls from a short rest to being relieved of duty for a period of time to enable sleep. A common subjective scale is the *Samn-Perelli Fatigue Checklist*, which is a seven-point scale as follows:

Samn-Perelli fatigue checklist

1	Fully alert
2	Very lively
3	Okay
4	A little tired
5	Moderately tired
6	Extremely tired
7	Completely exhausted

This checklist can be used throughout a shift, triggered by the following:

- start of shift (routine assessment)
- start of night shift
- following nap at work
- if shift is to be extended
- on call-in overnight
- if Level 2 assessment places the person in yellow or red zones
- colleague or supervisor notes symptoms
- individual experiences symptoms
- error committed or picked up
- incident.

Specific scores on the checklist can be used as thresholds to trigger a set of fatigue risk controls, as per the example following:

Example 3.1: Fatigue checklist		
Samn-Perelli fatigue checklist	Risk level	Controls
1–3	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
4–5	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> • Level 2 and 3 assessment • Individual controls.
6	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> • Document with unit director and/or EDMS • Level 2 and 3 assessment • Individual controls • Team-based controls • Support napping and safe-home policies.
7	Very high	Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.

Another form of Level 3 control involves individual or colleague assessment of symptoms of fatigue. The following checklist provides a range of typical symptoms of fatigue. While an understanding of these symptoms is a critical component of education about fatigue, they can also be used to trigger risk controls.

Typical symptoms of fatigue		
Physical symptoms	Mental symptoms	Emotional symptoms
<ul style="list-style-type: none"> • Yawning • Heavy eyelids • Eye-rubbing • Poor coordination • Head drooping • Falling asleep 	<ul style="list-style-type: none"> • Difficulty concentrating • Lapses in attention • Memory lapses • Poor communication • Lack of situational awareness • Errors 	<ul style="list-style-type: none"> • Quiet and withdrawn • Lethargy • Lacking in motivation • Irritable or bad temper

Key tasks: FRMS Level 3

These are the key tasks relating to Level 3 of the FRMS:

- Begin with the areas of high risk and areas in need of additional fatigue risk reduction identified through the fatigue risk scan process.
 - Assign roles, responsibilities and timelines at the unit level for Level 3 FRMS development.
 - Consider, where possible, undertaking a review of fatigue-related symptoms during each type of shift worked in the unit.
 - Develop Level 3 FRMS core principles for the unit.
 - Determine thresholds for fatigue risk management and develop specific Level 3 controls (Appendix 8 provides further examples and guidance).
 - Identify key monitoring strategies for the FRMS.
 - Submit draft Level 3 FRMS components to the unit and the facility Local Working Group for review.
 - Document final components of FRMS and schedule review date.
 - Undertake training for management and employees with respect to new Level 3 controls.
-

Level 4 and 5: Fatigue causing near-misses and incidents

Critical question: Was fatigue a causal or contributing factor in any near-miss or incident?

This last component of the Defences in Depth framework asks you to examine the everyday performance of your team and identify any instances when fatigue might be associated with errors, near-misses or incidents.

How do you currently learn from errors, near-misses or incidents locally? Levels 4 and 5 in the FRMS are designed to monitor the effectiveness of your Level 1 to 3 fatigue risk management strategies and identify any instances where the fatigue risk management activities for the unit/facility were insufficient to prevent fatigue resulting in an error, near-miss or incident.

To this end, Levels 4 and 5 act as an important monitoring and audit function within the FRMS. The aim of Levels 4 and 5 is to show lessons to be learnt when errors and incidents do occur, in order to strengthen the other controls where possible.

Tools at Level 4

Level 4 involves the systematic analysis of data relating to near-misses and minor incidents. This data comes from the OHS and the patient safety systems within Queensland Health. However, these systems may not be the only method you use for Level 4 and other tools, such as qualitative reports, observational data collection and informal clinical audit meetings, should all provide data at Level 4.

All error and near-miss reports should be analysed with respect to the possibility of fatigue as a causal or contributory factor. Any events in which fatigue has been identified as a potential causal or contributory factor should be subjected to further analysis that identifies why risk management strategies at Level 1 to 3 failed. That is, what was the working time arrangement, prior sleep history, or subjective fatigue levels that did not provide a trigger for risk management action?

Data should be collated and reported at regular intervals to the Local Working Group, and must trigger critical review of the existing Level 1 to 3 controls.

Tools at Level 5

Level 5 involves the detailed and systematic investigation of incidents and adverse events. This process mirrors that undertaken at Level 4, but due to the severity of incidents or adverse events, it is expected that a more detailed and sophisticated analysis should take place within the incident investigation or Root Cause Analysis (RCA).

Like the process in Level 4, incidents and adverse events should be analysed with respect to the possibility of fatigue as a causal or contributory factor.

Individual factors: Work/sleep history[†]

- Planned and actual work history (14 days).
- Actual sleep/wake history (72 hours).
- Time of day of event.
- Evidence from those involved and colleagues about symptoms of fatigue.

[†] Questions are being added to the RCA to investigate the role of fatigue in incidents. The individual(s) involved will be asked about the amount of sleep they had obtained in the previous 24 and 48 hours and how many hours they had been awake. Other members of the team will be asked to comment on whether people were displaying symptoms of fatigue.

Organisational factors: FRMS actions

- Rostering practices, overtime practices.
- Current staffing levels – staff on annual or sick leave and unfilled positions.
- History of fatigue reports from unit.
- Existence of FRMS policy within unit.
- Use of Level 2 and Level 3 controls (both systematically and on the day of the event).

Any events in which fatigue has been identified as a potential causal or contributory factor, should then be subjected to further analysis that identifies why risk management strategies at Level 1 to 3 failed. That is, what was the working time arrangement, prior sleep history or subjective fatigue levels that did not provide a trigger for risk management action?

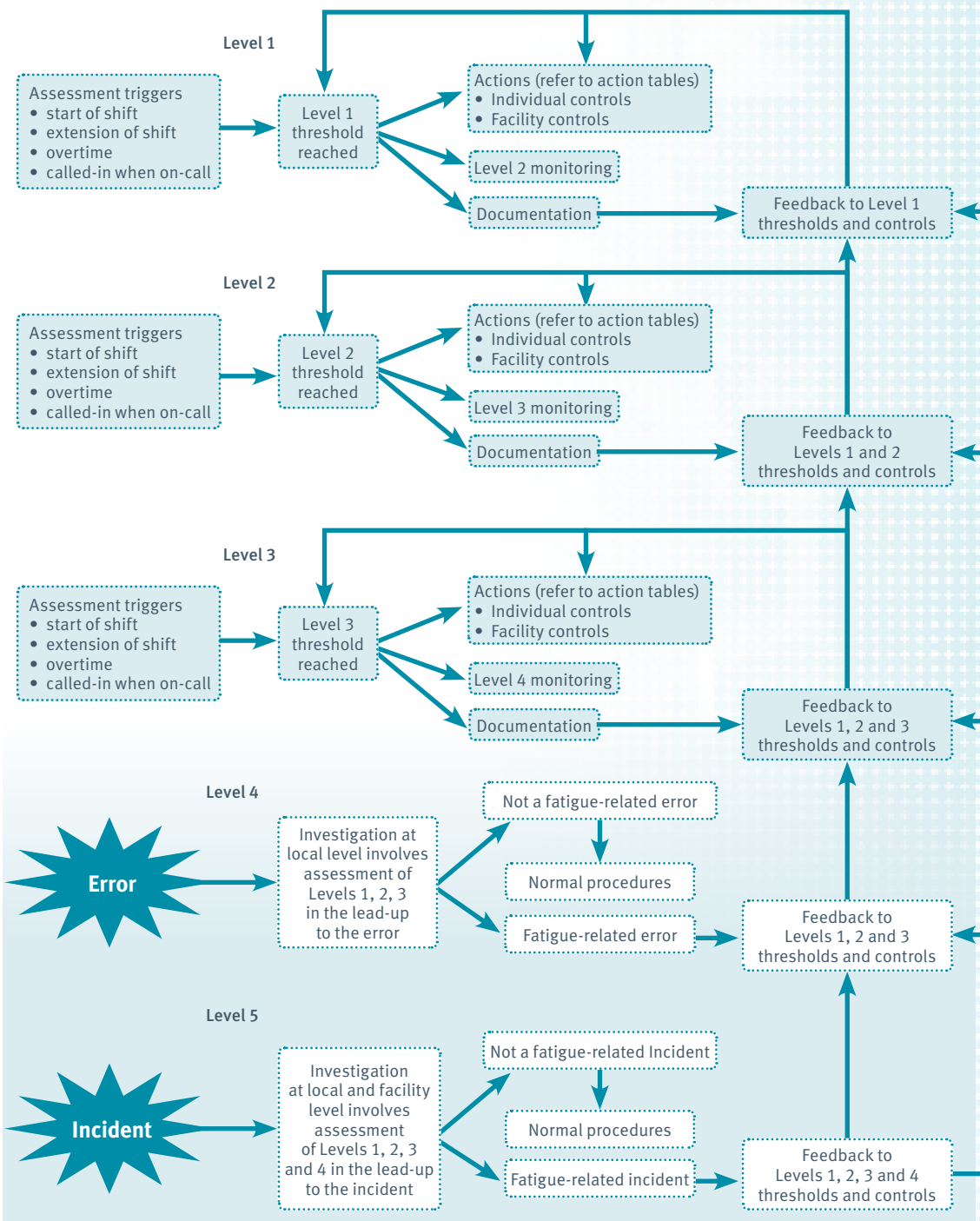
Data should be collated and reported at regular intervals to the Local Working Group and must trigger critical review of the existing Level 1 to 3 controls.

Investigation of, or discussion about errors and incidents, even minor ones, can help to identify systematic deficiencies in the FRMS, or where the FRMS is not being applied correctly or in the intended way. Discussion around errors or incidents should not be about assigning blame to individuals, but rather about helping everyone to learn, and most importantly, brainstorm alternative or future controls.

How is the FRMS continually reviewed and improved upon?

The schematic below demonstrates how each of the levels in the Defences in Depth feeds information back into the system as a continuous check and refinement process. When a Level 2 threshold, is reached a series of actions are implemented locally to manage the immediate risk. The actions that are triggered should also include an assessment of higher level thresholds and controls to determine whether those thresholds are appropriate.

Feedback from Defences in Depth framework



Key tasks: FRMS Levels 4 and 5

- Assign roles, responsibilities and timelines at the unit level for Level 4 and 5 FRMS development.
 - Undertake a review of existing data to determine the prevalence of fatigue-related incidents and also the level of reporting of fatigue within the unit.
 - Identify the core strategies for Level 4 and 5 data collection and analysis within the unit.
 - Submit draft Level 4 and 5 actions for feedback from the unit and the facility Local Working Group.
 - Document the Level 4 and 5 actions in the FRMS documentation.
-

Section IV

Determine a training process

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Education program

All medical officers, as part of the implementation of fatigue risk management systems within Queensland Health, will be required to complete mandatory education sessions. For most doctors the training will be accessed as on-line modules and the specific modules for completion will depend on their particular role in the facility.

Three modules make up the web-based education package:

Module 1: Fatigue-related risk and management at an individual level. This covers the scientific evidence about the role of inadequate sleep, long periods of wake and the circadian system in elevating fatigue-related risk. The specific aspects of performance that are affected by fatigue are discussed with particular emphasis on the healthcare setting. Information about fatigue countermeasures, such as napping and strategic use of caffeine is also provided.

Module 2: This module covers an overview of the Queensland Health policy on Medical Fatigue Risk Management, the implementation of a FRMS and the roles and responsibilities under the policy. This module is aimed at all medical staff.

Module 3: This module covers the requirements under the OHS legislation and how the implementation of an FRMS can address responsibilities under the Act. This module is aimed at district executive and all medical staff in a supervisory or managerial role.

The Local Working Group will determine the processes to ensure that all affected staff receive appropriate training.

Fatigue Risk Management Officers from each of the districts and those tasked with developing and implementing FRMS in Queensland Health facilities, will require more detailed instruction. Workshops will provide the theoretical framework underpinning FRMS and the process involved in developing an FRMS.

Section V

Complete FRMS and implement

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Working through this Resource Pack has enabled you to:

- assess the fatigue-related risk in your workplace
- determine the controls you already have in place, even though they are probably informal ie. not written down anywhere
- define the roles and responsibilities for people in your hospital and to understand the roles of the district and executive management in supporting you in managing fatigue-related risk in your hospital
- create and foster an environment that encourages reporting of instances of increased fatigue-related risk
- document the assessment and control strategies for fatigue-related risk that are tailored for your workplace
- determine the best education strategy for doctors and other key personnel.

It is now time to put the FRMS document for your unit/facility together. The template for doing this is provided as part of the Queensland Health Medical Fatigue Risk Management Policy.

Prior to implementation, you should consult with all key stakeholders in your unit/facility and allow adequate opportunity for review and feedback on the FRMS document.

Appendices

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Development of a change management plan

Queensland Health's Change Management Guidelines are available on QHEPS to assist with this process.

Building recognition of need to change

It is necessary to develop a need for change within each facility and individual unit. The lack of a sense of urgency and no catalyst for change within many of the case study sites made it difficult to implement change. In some of the case study sites, fatigue was not seen as a critical issue for performance or safety by some staff at all levels, and a sense of not being vulnerable was apparent. Excessively long working hours had become a cultural norm because of deeply entrenched historic practices within the healthcare profession.

Actions that establish the need for change within each facility and individual unit must focus on disrupting complacency and could include:

- publicising sentinel events where fatigue has been a contributing factor
- continued education about the impacts of fatigue on performance
- a consistent message from the organisation, colleges and associations that there is a need for change.

Delineating accountability and responsibility

The responsibility for employee and patient well-being needs to be formally defined and accountability for a safe system of work established within each facility and individual unit. During the case study process, it was identified that there was considerable referral of responsibility to 'the system' or 'the organisation' and evidence of learned helplessness within individual facilities and units.

Actions that establish accountability and responsibility for managing fatigue-related risk could include:

- clear delineation of accountability and responsibility for fatigue risk management
- mock trials where EDMS and unit directors are required to take the stand
- organisational requirement for EDMS and Directors of Units to report formally on fatigue risk management in their facilities.

Identifying industrial impediments to change

The *District Health Services Senior Medical Officers' and Resident Medical Officers' Award – State 2003 and Medical Officers' (Queensland Health) Certified Agreement (No. 1) 2005* contain explicit and implicit impediments to change. First, the current remuneration structure rewards excessively long hours of work and there is anecdotal evidence of overtime payments reinforcing work practices that elevate fatigue risk. Second, restrictions on establishing shiftwork for senior medical officers affect the ability of Queensland Health to effectively manage fatigue-related risk in a 24-hour operation. Finally, indemnity provided to doctors who are required to work fatigued, implies that fatigue is a normal and accepted part of working in Queensland Health. It is at odds with the shared responsibility model, and provides an industrial referral of responsibility for safe work practices from individuals to the organisation.

Whilst the emphasis of fatigue as a safety issue is critical, the current industrial context needs to be critically examined as part of the overall change management process.

Provision of resources for change – Allocating time for change

Within the individual facility or unit the management of fatigue risk requires a small but significant investment in time. In already stretched departments, in participating case study sites, finding even 30 minutes for meetings relating to FRMS development was extremely difficult, let alone the half-day workshops required to develop and embed components of the FRMS into work practices.

Actions that assist in the provision of resources for change could include:

- clear communication of the requirement to invest time in the development of fatigue risk management systems
- provision of locum resources to cover the time required to develop FRMS within each unit.

Investing in change agents – Local Champions

Experience to date has highlighted that success in case study sites has been closely linked to the strength of Local Champions. These are medical officers who are peers and who can dedicate time and effort to working with units in the development of FRMS.

Actions that assist in the development of these Local Champions could include:

- ensuring each site has a Local Champion for fatigue risk management
- analysing the training needs of Local Champions
- facilitating a Local Champion forum
- providing locum support to cover the clinical load of Local Champions.

Local Working Group

The Fatigue Local Working Group (LWG)

Building an effective FRMS will take more than just a commitment from the senior management and a motivated local champion. In addition to their significant involvement in development of the FRMS document itself, the LWG is charged with creating and maintaining a culture within the facility that allows the FRMS to be effectively implemented.

The LWG forms a vital part of the development, implementation and continued management of the FRMS document. Having a group specifically tasked with developing, documenting, implementing and reviewing fatigue-related risk in the hospital will ensure that if members of the group move on, the process is not significantly disrupted.

Who sits on the LWG?

An important process in the development of the FRMS document is deciding who will sit as part of the LWG. Informed decisions made at LWG meetings will form the basis of the FRMS document, so it is necessary to have people who know how the facility operates, and can advise whether thresholds and controls are realistic. With this in mind, it is advisable to have at least one medical officer as part of the group. Other individuals that may be valuable are the Local Champion, an OHS Officer, Patient Safety Officer, Nursing Unit Manager, Allied Health representative, Medical Superintendent/Director of Medical Services, Unit/Department Heads – all of whom can provide a range of insights into the running of various aspects of the facility.

While the FRMS is focused on the working arrangements of medical officers, having nursing, allied health, patient safety and administrative staff on-board will be essential to the successful and continued implementation of the FRMS.

Quorum details

Normal quorum rules dictate that a minimum of half the members plus one, is required for a decision to be binding. As a group, it will be important to consider whether members must physically be at every meeting or whether sending a stand-in delegate as a proxy is appropriate. While allowing proxies to come in place of a member will ensure the quorum requirement is met regularly, it will be helpful in the initial stages for the same members to attend meetings as decisions are unlikely to be resolved within the confines of a one hour meeting.

In the early stages of the FRMS document development it may be worth having additional rules with regard to quorum. For example, if there are four medical officers on the LWG, it may be decided that in addition to having half the members plus one, that at least half the medical officer contingent is present.

How often does the LWG need to meet?

Meeting requirements may change as the FRMS document moves from the development to the implementation stage. Monthly meetings should suffice initially and frequency can be reviewed after implementation.

What is the main role of the LWG after the implementation of the FRMS?

The LWG will have a clearly defined role during the early stages of the FRMS development and implementation. It will probably be this group that orchestrates the environmental scan and data collection and who will physically put the document together. Following implementation, the role of the LWG is less clearly defined but no less important.

Built-in to the FRMS will be documentation of the frequency and nature of threshold violations, fatigue report forms, etc. This documentation will form the basis for the ongoing review process of the FRMS. In order to best use this information, time should be made to review this documentation regularly. Additionally, prospective and/or retrospective roster analyses may also be discussed.

As a facility, it needs to be decided if/whether the LWG remains as a group or whether fatigue risk management (including the review of the documentation/information) is made part of an existing meeting.

LWG agenda examples

Example 1: General items for discussion

- Review of on-call workload (night and weekend work)
- Review on-call facilities
 - Where are they?
 - Are they suitable?
 - Does anyone use them, if not, why not?

FRMS Document Development

- Level 1 thresholds to be decided based upon discussions from previous meeting
- Identify existing Level 2 controls – to be discussed with particular reference to day-shifts following on-call nights

What currently happens if a medical officer has not slept (eg. busy on-call)?

Example 2: General items for discussion

- Handover procedures after on-call nights
- Current use and documentation of fatigue forms and fatigue leave.

FRMS document development

- Level 2 thresholds to be decided based upon discussions from previous meeting
- Level 3 assessment.

Self-assessment and collegial – mandatory as part of every shift or only when Level 1 and/or 2 thresholds have been reached?

Fatigue risk register

The fatigue risk register is a critical tool used in the management of fatigue-related risk in the organisation. The fatigue risk register enables systematic documentation of the findings of the formal fatigue risk scan and the ongoing monitoring of current fatigue risk management activities. The main question when assessing the fatigue-related risk for your unit/facility is:

Can we put our hands on our hearts and say we are currently doing everything reasonably practicable to manage this risk?

To be able to effectively answer this question, an initial fatigue risk scan needs to take place to identify the specific occurrences of fatigue-related risk in an individual unit or facility. Specifically, the questions that should be addressed in some detail are:

- When is fatigue-related risk increased for us – when in the roster or the day or the week or the year is risk increased?
- When fatigue-related risk is increased, who is it impacting – is there a specific group of doctors within the hospital/department that are at increased risk due to the nature of their work arrangements?
- How does the increased risk impact – what tasks are susceptible to fatigue, how does performance change, is the patient or doctor at risk or both?

Identifying fatigue risk

The first step in developing the fatigue risk register involves identifying the work-related and personal factors that can give rise to fatigue-related risk. From the perspective of work-related factors, this process of risk identification should look at the following five key areas where fatigue can arise:

Shift length: the length of individual shifts of work

Number of consecutive shifts: the number of consecutive shifts before short breaks of one to two days

Time off: the length of time off between individual shifts

Night work: the amount of work undertaken at night, at odds to our natural circadian rhythms
Long breaks: the frequency of breaks longer than two days.

Other issues that should be addressed when evaluating fatigue risk include a range of individual and personal factors, such as:

Workload: the pace of work undertaken

Type of work: the relative risk of work tasks, such as complex surgical procedures or clinic work

Concurrent study: the demands of concurrent study for registrars and junior doctors

Individual factors: the impact of commuting, young children and other factors on obtaining rest.

Assessing current controls

It is important to identify the current strategies used to manage each type of fatigue-related risk in your facility. First, this process is about documenting all the informal strategies that have been developed over the years. Each facility develops a range of strategies, often unique, that are used to manage the risks associated with fatigue in the workplace.

It is critical that these strategies are documented and assessed in terms of how effectively they manage or mitigate the risks associated with fatigue. This assessment should pose two relatively simple questions:

***Are we currently doing everything we practically can to manage the risk associated with fatigue in our workplace?
What residual risks are remaining in our workplace, that we do not yet effectively manage?***

In some instances, the answer will be: 'yes – over the years we have developed strategies to effectively manage the risk of fatigue'. For instance, a strategy of monitoring night on-call work is in place, and when doctors have not slept, they are relieved of duty. The process now is simply to document this existing risk management strategy and ensure the procedure is known by all staff and remains effective in managing that fatigue risk.

However, each individual fatigue risk on the register needs to be carefully assessed. When an identified risk that is found not to be effectively managed, additional controls within the Defences in Depth framework should then be identified.

Identifying additional controls

The process of identifying additional controls is a difficult, yet critical component of the FRMS. This component requires innovative thinking and asks the hard question:

What do we need to do differently to reduce the specific fatigue risk to an acceptable level?

Solutions such as 'we need more staff' might not be achievable or effective in managing a specific fatigue risk. Therefore, practical, achievable and workable solutions need to be developed. The LWG is a good forum for innovative thinking and sharing lessons across units of facilities is helpful.

Sometimes it is not possible to remove a specific fatigue-related risk. For instance, with limited staffing resources – and in the context of maintaining some service delivery to sick patients – it might be necessary to work when fatigued. In this context, it is critical that the risks associated with impaired performance are examined and the focus is placed on developing 'error tolerant' systems of work. Performance protection strategies, such as cross-checking, teamwork and generally 'keeping an eye on each other', form an important part of the risk management process.

Planning action

Once fatigue risks have been comprehensively identified and assessed, the risk management strategies need to be planned and roles and responsibilities for actions need to be assigned.

The LWG should form the oversight and should monitor the progress of fatigue management actions and ensure the controls put in place are functioning.

Maintaining the fatigue risk register

The fatigue risk register must be a 'living' document – as circumstances change in the unit or facility, so does the profile of fatigue-related risk. For instance, changes in areas such as staffing levels, workload and on-call loads, can lead to additional fatigue-related risk. These risks need to be captured in the fatigue risk register and the effectiveness of current controls needs to be assessed.

The fatigue risk register should be updated at each LWG meeting and can form an evolving record of the fatigue risk management activities of the unit or facility. Some facilities may want to include fatigue on the district risk register, rather than establish a separate process.

Example: Fatigue risk register

Current controls	Additional controls	Actions	Date and responsibility for completion
Risk: Overnight on-call periods (General Medicine)			
<ul style="list-style-type: none"> no more than 1 in 4 on-call at 14 hours continuous work, notify supervisor and make plans for rest 	<ul style="list-style-type: none"> Second on-call person Bed for napping at hospital 	<ul style="list-style-type: none"> Roster redesign Napping facility 	22/02 John Smith
Risk: Junior doctors on at night with minimal supervision (Neurosurgery)			

Data collection guide

Data collection

The data collection process begins with the facility, perhaps lead by the LWG, deciding toward whom the data collection needs to be directed, for what duration of time and the type of information that is of most interest.

It is important to remember that there are many options in terms of the data collection process. Each facility should choose methods of data collection and assessment that suit their needs and capabilities.

An environmental scan should precede data collection and will help to identify any fatigue risk 'hot spots' which should form a/the main focus of the data collection. As long as the data is collected with a view to gaining sleep/wake/work information about these 'hot spots', there is no right or wrong way to go about it.

Data collection tools

Depending on a number of factors, collecting data may be as simple as:

- recording basic information about each shift for a couple of weeks
- collating data that is already being collected (eg. fatigue report forms, overtime forms, fatigue leave, error and incident data, etc)
- completing detailed sleep and work diaries.

Alternatively, the process may be out-sourced to involve capture of sleep/wake patterns using objective measures, such as activity monitors and fatigue assessment using PDA based software.

All of these tools are just guides. Each facility should opt for data collection methods that are suitable in terms of the data it wishes to capture and the resources it has to collect/analyse the data.

More specific tools are outlined at the end of this Appendix. Following are examples of tools that can be used to facilitate the data collection process.

Who collects data?

Depending on the size of the facility, it may be reasonable for all medical officers to collect data. However, in larger facilities it may be more practical to target certain departments or smaller groups within each department. It is also advisable to target both senior and junior medical officers.

Despite how the LWG and facility decide to go about the data collection process, consideration needs to be given to ensuring the sample of people is representative of the particular department and/or facility. For example, if there are ten senior medical officers in the Emergency Department, collecting data from just one or two of them is not going to be a representative sample.

How long to collect data?

The length of time to collect data should be dictated by what the LWG and facility want to find out and by the current roster. For example, if the interns currently work a two-week roster cycle, then it would make sense to collect data for one complete cycle. Alternatively, if weekends are identified as being particularly problematic in terms of consultant workload, then data collection can be organised to maximise data collected on weekends.

Data analysis

Given that different rosters are typically worked in different departments and across different parts of the continuum of medical education and training, it is advisable to combine and analyse data for different groups. For example, all the registrars from the department of Anaesthetics or the consultants from General Surgery.

How the data is collated and analysed will depend on the main questions and the amount of data to be collected. Here are a few basic analyses and comparisons that can be made at Levels 1 to 3:

Level 1

- How often day shifts are extended beyond the rostered hours and by how long
- Shift duration
- Number of consecutive days worked (include all work – even short shifts).

Level 2

- Sleep obtained when on-call compared to nights not on-call nights
- Sleep obtained in the 24 hours prior to the start and end of shift
- Prior wake (ie. number of hours since waking) at the start and end of shift.

Level 3

- Fatigue at the end of shift/sleep compared to the beginning of the shift/sleep
- Whether pre/post shift fatigue increases across consecutive work days.

For all data, it is important to calculate means, but also to look at the range of data (ie. maximum and minimum values). For most facilities, mean shift duration, total sleep time and so forth will probably be at acceptable limits. However, there will always be isolated instances of inadequate sleep, extended periods of wake, very high fatigue and long shifts. How the facility decides to manage the fatigue-related risk associated with these instances will form the basis of the FRMS.

What to do with the data?

The main aim of the data collection will be to inform the LWG about objective sleep/wake/work data within the facility and to use that data to build the FRMS document.

Individual and/or departmental feedback to the staff that participated in data collection can also be a valuable process.

Specific data collection tools

1. The sleep/wake/work assessment tool

This form would ideally be completed before and after each shift and collated for a number of medical officers over a number of weeks. It will provide valuable information about work, prior sleep/wake and could be easily translated into the format of the FRMS.

Type of shift:	<input type="checkbox"/> Day	<input type="checkbox"/> Night	<input type="checkbox"/> Call-In
Shift start:	Pre-shift fatigue: 1 2 3 4 5 6 7		
Sleep in prior 24 hours:	Prior 48 hours:		
Prior wakefulness:			
Shift end:	Post-shift fatigue: 1 2 3 4 5 6 7		
Sleep in prior 24 hours:	Prior 48 hours:		
Prior wakefulness:			
Samn-Perelli fatigue checklist			
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, very difficult to concentrate			
7. Completely exhausted, unable to function effectively			

2. Diaries

2a. Work diaries

There is probably a mechanism already in place to capture start and end times, such as master rosters and overtime forms. However, it may be worth generating a separate diary for the purposes of data collection (an example follows). In addition to work start and end times, built into the work diary should be a fatigue and/or workload index. Collating this data will enable the LWG to determine whether there are certain factors, such as work patterns and times of the day, where fatigue and/or workload levels are particularly high.

Example: Work diary

DUTY DIARY					
	Start Date/Time ddhhmm	Pre-Work Fatigue Level	End Date/Time hhmm	Post-Work Fatigue Level	Remarks
eg	28 0600	1 2 3 4 5 6 7	0832	1 2 3 4 5 6 7	
1		1 2 3 4 5 6 7		1 2 3 4 5 6 7	
2		1 2 3 4 5 6 7		1 2 3 4 5 6 7	
3		1 2 3 4 5 6 7		1 2 3 4 5 6 7	
4		1 2 3 4 5 6 7		1 2 3 4 5 6 7	
5		1 2 3 4 5 6 7		1 2 3 4 5 6 7	

Fatigue and workload information during on-call periods should also be captured in a separate section/diary. For example, if it is of particular interest to examine the level of disruption to sleep opportunity when on-call, there should be a section in the diary to record all on-call activity – including phone calls (duration and timing) and whether or not medical officers were woken by the calls.

Example: On-call diary

REMOTE ON-CALL PHONE DIARY							
	Call Date/Time ddhhmm	End Time hhmm	Sleep or Awake when called	Required to Attend	Fatigue Level	Nature of Call	
eg	27 2300	2310	☉ W	Y ☹	1 2 3 4 5 6 7	EL EM WR CL NC	Registrar called for advice
1					1 2 3 4 5 6 7	EL EM WR CL NC	
2					1 2 3 4 5 6 7	EL EM WR CL NC	
3					1 2 3 4 5 6 7	EL EM WR CL NC	
4					1 2 3 4 5 6 7	EL EM WR CL NC	
5					1 2 3 4 5 6 7	EL EM WR CL NC	
6					1 2 3 4 5 6 7	EL EM WR CL NC	

2b. Sleep diaries

The amount of sleep obtained prior to shifts will form an important part of the FRMS. Knowing what shifts (eg. night shifts, on-call nights, weekend on-call, remote call, proximal call shifts) or shift patterns are associated with reduced quality or quantity of sleep will aid in the risk management process.

Similar to the work diaries, sleep diaries should have a pre/post sleep fatigue index, as well as a subjective sleep quality index. Having space for and encouraging medical officers to provide written details/comments about their sleeps may also be useful in the data collection process.

Example: Sleep diary

SLEEP DIARY							
	Sleep Location	Start Date/Time ddhhmm	Pre-sleep Fatigue Level	End Time hhmm	Post-sleep Fatigue Level	Sleep Quality	Remarks
eg	☉ C O	27 1400	1 2 3 4 5 6 7	2130	1 2 3 4 5 6 7	1 2 3 4 5 6 7	
1			1 2 3 4 5 6 7		1 2 3 4 5 6 7	1 2 3 4 5 6 7	
2			1 2 3 4 5 6 7		1 2 3 4 5 6 7	1 2 3 4 5 6 7	
3			1 2 3 4 5 6 7		1 2 3 4 5 6 7	1 2 3 4 5 6 7	
4			1 2 3 4 5 6 7		1 2 3 4 5 6 7	1 2 3 4 5 6 7	
5			1 2 3 4 5 6 7		1 2 3 4 5 6 7	1 2 3 4 5 6 7	

Sleep and work diaries should be kept in conjunction with each other.

3. Objective assessment tools

Activity monitors

If available, activity monitors are an excellent tool for objective quantification of sleep quality and quantity. About the size of a watch and fitted with an accelerometer, activity monitors are worn on the wrist and capture 'movement'. When used in conjunction with a sleep diary, they provide valuable information about sleep duration and sleep quality (as indicated by the amount of movement in any given sleep period).

Importantly, activity monitors are not a 'stand-alone' data collection tool, and sleep and work information must be collected together.

The scientific basis for risk thresholds

Level 1 – Hours at and away from work

At Level 1 of the Defences in Depth framework, thresholds are based around rostered hours worked, actual hours worked and time away from work. The evidence to follow will show that beyond the 'regular' eight-hour day, every extra hour at work has the potential to contribute to fatigue and fatigue-related risk. Fatigue will also increase with every consecutive day worked. Consecutive hours spent away from work (recovery time) also forms the basis of Level 1 thresholds.

Hours at and away from work (shift length and sleep opportunity)

There is clear evidence in the field that demonstrates an increase in fatigue (reflected by subjective and/or objective indicators) as a function of time-on-task, that is hours at work. As one example, the data collated by Folkard and Tucker (2003),² across a range of industries, was able to express relative accident risk as a function of hours at work. The data showed that accident risk increased nearly exponentially with hours at work. Additionally, it was also found that at the twelfth hour of a shift the relative accident risk was double compared to the first eight hours of the shift, clearly demonstrating increased risk beyond a 'typical' eight- to nine-hour shift.

Time off between shifts is equally important and should allow for sufficient sleep for recuperation prior to the next shift. It has been clearly demonstrated in the laboratory that when sleep is restricted for a couple of nights or more, workers could be at risk of performance impairment and increased levels of sleepiness and fatigue for subsequent shifts.³⁻⁸ Between shifts, Knauth (1997)⁹ for example, recommended that adequate resting time should be greater than 11 hours. This guideline is made in light of the fact that 11hours time off does not equal 11hours sleep. Commuting, eating and other personal needs must also take place in this time. When rest periods are shorter than this, sleep may be significantly curtailed.¹⁰⁻¹²

There is field data to support the intuitive idea that longer breaks from work provide longer opportunities to sleep and, in general, are associated with more sleep. As one example, in a study looking at the amount of sleep obtained by locomotive engineers between successive shifts, it was found that workers reported an average of 5.2 hours, 6.5 hours and 8.9 hours sleep for breaks of 12 hours, 16 hours and 24 hours respectively.¹³ In another field study, it was demonstrated that train drivers who were given an eight-hour rest period between successive shifts never obtained more than 5.3 hours sleep, even when the sleep opportunity occurred across the night.¹⁴

Importantly, when determining what constitutes an adequate sleep opportunity, giving consideration to the time of day is a crucial. When time off occurs across the night, the circadian system is programmed to facilitate sleep and sleep will be obtained more easily. Day-time sleep opportunities however can be significantly shorter (up to four hours)^{15, 16} compared to sleep at night. In one study, using a simulated triage scenario, it was demonstrated that emergency physicians slept an average of almost three hours less during the day (5.4 hours) compared to night sleeps (8.3 hours).¹⁷

Consecutive shifts

In addition to consecutive hours spent at work, fatigue increases across consecutive days/nights at work. Tilley et al (1982),¹⁶ using simple performance tasks, showed that response time performance deteriorated as a function of days into a shift-cycle. This is similar to the finding of Petrilli et al (2006),¹⁸ who showed hours into a long-haul flight to be a significant predictor of pilots' response speed. Therefore, consideration should also be given to the number of consecutive days/nights worked, even when each individual shift is of an acceptable length. This research is particularly pertinent when considering consecutive night shifts, where sleep opportunity occurs during the day.

Similarly, there is evidence to show that sleep when on-call is also substantially reduced, with up to 68 per cent and 57 per cent of first and second year graduands in one study reporting an average of only two hours (or less) when on-call.¹⁹ Following a series of night shifts or on-call shifts, a significant sleep debt may have been accrued. Laboratory research suggests that in order to recover this debt, workers will require consecutive sleeps at home. Indeed, in one laboratory study, it was shown that when sleep was restricted to five hours or less per night for a week or more, not only did individuals perform with significant impairment and experience elevated levels of fatigue, but after three eight-hour sleeps, they had not completely recovered.⁶ Application of these data suggests that following a seven-day schedule where sleep is restricted, three days off may not be enough, particularly if sleep during the day when sleep quality (subjective and/or objective) may not be as good.^{16, 20}

Summary of main messages – Level 1

- A reduction of extended work shifts has the capacity to reduce fatigue, with evidence showing increases in fatigue/accident risk beyond an eight- to nine-hour day.
- Longer breaks from work will typically result in more sleep with some data showing that a 16-hour break is required to ensure seven to eight hours sleep.
- Recovery must also be thought of in terms of time following a shift-cycle (which may simply be the weekend following the five-day working week). Longer recovery may be required following night-shifts where a larger sleep debt is likely to have been accumulated.

Level 2 – Prior sleep and wakefulness

Inadequate sleep and prolonged wakefulness can both result in increased fatigue levels and at Level 2, thresholds are based around these two factors; sleep and wake. The amount of sleep needed and duration of wakefulness that can be withstood varies between individuals. However there is good laboratory and field-based evidence showing there are thresholds for both these factors that, once reached, will diminish the safe-work capacity of any individual. Importantly, subjective estimates of fatigue do not always align with prior sleep/wake. It is important to have thresholds with regard to sleep/wake variables.

What is inadequate sleep?

The impact on performance ability of a whole night without sleep is relatively intuitive. The impact of reduced sleep is less so. However, the research field of sleep and fatigue is only now coming to terms with the true impact of sleep restriction. That is, obtaining inadequate sleep for a number of consecutive nights. In fact, the impact of moderate sleep restriction may be more profound when a sleep debt has accumulated, that is when sleep is restricted over two or more nights.

Studies in recent times have consolidated the idea that sleep restriction will result in significant impairment to waking functions. In two studies, authors systematically investigated differences between various levels of sleep restriction. Van Dongen et al (2003)⁵ and Belenky et al (2003)⁶ both illustrated that sleep restriction for seven days produces measurable changes in waking performance. Sleep opportunity was restricted to seven hours, five hours, three hours⁶ or six hours, and four hours⁵ for seven and 14 nights respectively.

When sleep opportunity was reduced to less than seven hours, there was significant impairment to performance and that impairment increased in a dose-dependant manner, that is those participants receiving a four-hour opportunity each night were more severely impaired than those receiving a six-hour opportunity each night. Their findings illustrated that every hour extra obtained per night is of behavioural benefit.

Interestingly, the study by Van Dongen et al (2003)⁵ showed that when sleep opportunity was restricted to either four hours or six hours impairment did not stabilise, that is, the participants became increasingly fatigued and did not adapt to the restricted sleep regime. Moreover, this study was able to directly compare this chronic (greater than one week) sleep restriction with total sleep deprivation. They reported that two weeks of restriction to six hours per night induced impairment equivalent to one night with no sleep and that at four hours per night, impairment was equivalent to two nights with no sleep. These studies clearly demonstrate that over the course of a week or more, there is a cumulative effect in terms of performance deficit. Continued sleep restriction (less than six hours), even if only moderate, will result in significant impairment to waking functions. Importantly, these deficits may be comparable to that induced by total sleep deprivation.

How long is too long to be awake?

Research continues to illustrate that when wakefulness is extended beyond what is normally experienced (16 to 18 hours) impairment on various cognitive functions will result. Impairment can manifest as slowed response speed,²¹⁻²⁷ increases in attentional lapse frequency^{5, 22, 27, 28} and can also affect aspects of memory^{23, 29-31} simple addition/subtraction ability^{29, 30, 32, 33} and decision making.³⁴

While the impact of 24 hours (or more) without sleep is intuitively associated with performance impairment, an individual does not have to have gone without sleep for 24 hours before impairment will begin to manifest. A good example comes from a laboratory study that mapped performance across a 28-hour period of continued wakefulness.²¹ Results found that from the seventeenth hour of wakefulness, there was a linear decline in performance with a 0.6 to 3.3 per cent increase in impairment per hour compared to baseline (one hour of wakefulness). Moreover, this study was able to quantify the impact of extended wakefulness in terms of blood alcohol concentration (BAC) and found that after just 20 hours awake performance impairment was comparable to that seen in participants with a BAC of 0.1 per cent.

Notably, in this situation circadian factors (20 hours of wake occurred in the early hours of the morning), as well as extended prior wakefulness, would be contributing to poorer performance at this time. Importantly however, this is the exact situation medical officers might find themselves in when a day-shift has been extended due to an emergency or they are on-call and required to attend a situation before they have had the chance to go to bed. Society readily accepts that our ability to perform safely is hindered by alcohol consumption and these data show that in certain circumstances, being awake for too long will impact in the same way.

In addition to decreases in performance, one's ability to voluntarily stay awake decreases with hours of wakefulness.^{26, 35} Admittedly, most of the literature illustrating this is laboratory based, where ability to stay awake is typically measured in a static environment. Nonetheless, this provides valuable insight to the impact of extended wakefulness that may not be pertinent to work tasks, but to the more monotonous and familiar task of driving home for example.

Summary of main messages – Level 2

- When sleep is reduced to an opportunity of up to six hours (equating to approximately 5.5 hours) sleep for consecutive nights, performance impairment will result. If sleep restriction continues, impairment may continue to increase in a dose-dependant manner, that is the less sleep, the greater the impairment.
- Chronic sleep restriction can result in impairment that is equivalent to one or two nights total sleep deprivation.
- Extended wakefulness that coincides with a circadian low point can result in impairment comparable to that resulting from a BAC of 0.1 per cent.
- The impact of prior wakefulness can be exacerbated by circadian factors. For example, if a day shift extends into the night, a worker will be experiencing fatigue associated with extended prior wakefulness, in addition to the inherent fatigue associated with being awake at a time when the body is programmed to be asleep.

Level 3 – Signs and symptoms of fatigue

As illustrated at Level 1 and 2, time at work, reduced sleep opportunity, long periods awake and reduced sleep can all result in increased fatigue. However, there are other instances where adequate sleep will have been obtained, prior wakefulness is not high and the particular individual has only just started work yet they are still experiencing fatigue. Commonly in 24-hour operations, work that extends into the night and/or the early hours of the morning, are associated with elevated levels of fatigue, regardless of prior sleep/wake/work variables.

Feeling fatigued

Subjective assessments of fatigue have been used in numerous field-based studies investigating workers from a range of different industries including healthcare workers,²⁰ airline pilots,^{18, 36} automobile workers³⁷, fire fighters³⁸, naval seamen³⁹ and those associated with the rail industry.⁴⁰⁻⁴⁴ Almost without exception, data illustrates that individuals will report high to severe levels of sleepiness and/or fatigue when working night shifts (for example).^{15, 20, 38, 42, 44, 45} One study, looking at nursing staff, showed that nearly 20 per cent of those working night or rotating shifts reported they had at some point in the last month struggled to stay awake whilst on the job. Less than 4 per cent of day and evening workers reported such difficulties.²⁰ Similarly, a more recent study focusing on the Finnish rail industry found the risk of severe sleepiness during night and morning shifts was six to 14 times, and two times higher compared to a day shift respectively.⁴⁵ In the study by Hack et al (2003),⁷⁰ data showed a reduced incidence of attention lapses (captured objectively) when working fewer extended shifts, but in the traditional and intervention shift schedule, attention lapses were higher during the night.

Knowing when you are fatigued

Most studies documenting subjective fatigue reports during sleep restriction have illustrated that when sleep is restricted to below baseline levels (approximately eight hours), individuals will report higher levels of sleepiness (for example).^{5, 7, 8} Though in some studies, changes may not be observed until sleep each night is more severely restricted (up to three hours).⁶ However, the complexity of subjective ratings and their relationship with objective measures becomes evident however, when sleep is restricted more chronically. Recent data demonstrated a clear discrepancy between subjective reports and measures of waking functions (neurobehavioural performance) during sleep restriction.⁵ More specifically, their study⁵ suggested that an individual's ability to reliably assess their level of sleepiness or impairment does not match actual levels of fatigue or impairment when sleep is restricted chronically (a week or more).

There are other investigations that have reported similar results, where the physiological and/or objective measures indicate increasing fatigue but subjective measures do not correspond.^{6,7} For example, Carskadon and Dement (1981)⁷ showed that despite continued increases in daytime sleep tendency (ability to fall asleep) from the second to the seventh day of restriction, subjective reports plateaued after just four nights. The participants in the cited studies were becoming increasingly fatigued, but this was not necessarily reflected subjectively. From a practical perspective, these findings have important safety and productivity implications for individuals with chronically restricted sleep schedules. For example, shift-working populations, including those working in healthcare facilities may be largely unaware of their impairment. With data such as these in mind, monitoring (both oneself and others) of physical, mental and emotional symptoms becomes particularly important.

What are the symptoms of fatigue?

Individuals will exhibit different and varied physical symptoms when they are fatigued. While the more obvious symptoms include yawning, difficulties in staying awake and moodiness, fatigue can manifest in a number of other ways that include but are not limited to:

- poor communication, concentration and coordination
- head drooping
- eye-rubbing and/or heavy eyelids
- general feelings of lethargy
- errors
- lacking in motivation and situational awareness
- lapses in attention.

Summary of main messages – Level 3

- Significant fatigue may still be experienced late at night and in the early hours of the morning, regardless of prior sleep/wake/work variables.
- Research shows the subjective experience of fatigue may not necessarily align with objective indicators.
- Fatigue will manifest differently in different individuals and assessment of fatigue should involve self and collegial assessment of 'symptoms'.

Healthcare-specific research

Research conducted specifically in the field of medicine has shown that extended hours at work are associated with increases in fatigue and in some cases, adverse clinical events. Smith-Coggins (1994)¹⁷ for example, showed that emergency physicians were at an increased likelihood of making errors toward the end of their shift in a simulated triage situation, regardless of whether it was a day or night shift. Similarly, using data collected from interns, Chow et al (2005)⁴⁶ reported half of all near-miss events occurred during extended on-call shifts, with a peak in near-miss frequency when interns had worked 12 to 20 hours. In more experienced medical officers in the United States of America (residents), survey data has revealed that 42.1 per cent of respondents regularly worked extended hours (81 to 100 hours per week) and that 77.6 per cent cited fatigue as a reason for wanting to limit their hours.¹⁹ This evidence is in accordance with that found for other industries.

There are current regulations in Australia, New Zealand, the United States of America and Europe that cap the number of hours worked by medical officers per week. In the past, concern about lack of sleep and extended wake has been addressed by modifying work hours in this way. However, even if weekly hours at work are restricted rosters can still leave medical officers vulnerable to extended wakefulness and lack of sleep. That is, weekly work hours can be reduced to 48 hours for example, but if those hours are comprised of two 24-hour shifts, the net result is not likely to be a reduction in fatigue or fatigue-related risk. Modification of work hours and fatigue management in general, needs to be more considered than just reducing work hours.

A reduction in total hours worked (per week/month) can assist in the management of fatigue-related risk. However, the risk can be managed even more effectively by targeting modifications toward work hours that improve sleep and sleep opportunity. Effective modification of work hours in this way was clearly demonstrated in a comprehensive study detailed in two papers.^{47,48} Both of these papers documented changes to work performance and/or fatigue after an intervention into work hours.

On the traditional schedule, 42 per cent of all work hours occurred when interns had already been working (or rostered) for the previous 16 hours, compared with the 96 per cent in the intervention schedule. Lockley et al (2004)⁴⁸ compared the frequency of objectively measured fatigue (quantified physiologically using attention lapses) in two work schedules. During the intervention, there were significantly fewer attention lapses. This decrease was evident both at night (where incidence was more than halved) and during the day. Results reported by Landrigan et al (2003)⁴⁷ were similar with data showing that interns made 35.9 per cent and 20.8 per cent more serious medical errors and serious medication errors on the traditional schedule. Additionally, Lockley et al (2004)⁴⁸ was able to quantify sleep during the two schedules and found that interns slept 5.8 hours more per week during the intervention. This data clearly demonstrates that if extended wakefulness is decreased and exposure to night time sleep opportunities is increased through modification of work hours, there will be clinically significant outcomes in terms of performance and safety.

In the medical field, there is limited data that has specifically investigated the impact of sleep and extended wakefulness in medical officers, and the implications for their at-work performance and safety. However, the available data clearly show that by reducing work hours in ways that have the potential to improve sleep and limiting exposure to extended wakefulness, fatigue (physiological and behavioural) and its consequences, can be effectively reduced.

Fatigue countermeasures

See Appendix 8 for a list of fatigue risk mitigation strategies that include individual and team-based countermeasures. Two of the most commonly employed fatigue countermeasures used by individuals are napping and caffeine. This section discusses what is known about the efficacy of both naps and strategic use of caffeine in managing the alertness and performance changes that arise as a result of increased fatigue levels.

Napping

Literature on napping covers a broad range of protocols. Specifically however, the main issues that have been addressed are associated with the length and timing of the nap in the 24-hour day. Critically, these studies have also examined the sleep inertia effects following waking from the naps. Sleep inertia refers to a period of disorientation and performance impairment that is experienced immediately upon waking. As a consequence, the potential for error and incident during the sleep inertia phase is high. Thus, the alertness and performance changes following naps have been investigated from the time of waking through to several hours.

Naps taken in the early afternoon hours, during the post-lunch dip, have been shown to be effective at improving alertness and performance for several hours following the nap.^{49, 50} While afternoon naps are useful in some settings, it is often the night shift hours that represents the highest risk for errors and incidents associated with fatigue. As a result, research has also focused on identifying the ideal nap length for maximum benefit.

Some of the first studies to examine napping during a night shift used naps of one hour or longer. While naps of 60 minutes or longer were shown to improve performance, compared to no nap, the effects were delayed due to the influence of sleep inertia.⁵¹ That is, the beneficial effects of the nap on performance in particular, were not obvious for a significant period of time, reducing the feasibility and practicality of the nap as a workplace strategy. As a consequence, shorter naps have been examined during the night shift with the aim of reducing the effect of sleep inertia, but also providing a more practical option during a work period.^{52, 53} Naps of less than 30 minutes in length do provide measurable boosts to alertness and performance that are seen almost immediately upon waking and extend for a few hours.

Caffeine

The use of caffeine as a countermeasure to fatigue has been shown to be effective by increasing alertness, sustaining wakefulness and delaying sleep onset. Caffeine use has been associated with increase in cognitive performance such as sustained vigilance, reaction time, memory and mood. Subjective measures of sleepiness and alertness have also been examined and caffeine has been found to decrease subjective sleepiness and increase subjective alertness. Caffeine has also been shown to be associated with effects on sleep, including changes in sleep architecture (time spent in each stage of sleep), total sleep time, sleep onset and efficiency.

The literature on the use of caffeine in sustaining performance and alertness covers a broad range of issues. The strategic use of caffeine as a countermeasure to the effects of fatigue has, in general, been found to be beneficial. The main issues of importance to be aware of are the short-term benefits in cognitive performance and alertness, the residual effects which may affect recovery sleep quality and duration, and the individual variation to these effects. An important point to be aware of is the individual differences in tolerance to caffeine can vary greatly; therefore the effects will also vary greatly.⁵⁴

Dosage variation (time, amount and ingestion)

In considering the use of caffeine, it is important to be aware of certain factors which influence its effects. The quantity and type of dose (a fixed dose or dose-response relationship), the amount of sustained wakefulness and prior sleep obtained before ingestion, and the time of day that caffeine is taken, all can vary its benefits.

The recommended dosage for a prolonged and significant reduction in sleepiness during a night without sleep has been suggested at 400mg of caffeine. However, this is equivalent to about five to six cups of coffee and is not always a feasible or realistic option. Such a high level of caffeine is not reasonably obtained through drinking coffee or 'energy drinks' and would need to be taken via tablet form.⁵⁵ A recent review on psychostimulants as countermeasures to fatigue has concluded that 200mg (two to three cups of coffee) is effective.⁵⁶ Caffeine taken in this manner (consumed through coffee or energy drinks) takes about 30 minutes to become effective.⁵⁷

Sleep restriction versus sleep deprivation

The amount of previous sleep and sustained wakefulness can alter the duration and extent of the positive effects of caffeine. With restricted sleep (five hours sleep) it has been shown that 200mg of caffeine (equivalent to two to three cups of coffee) can be effective in reducing objective sleepiness (EEG activity, lane drifting) and subjective sleepiness (subjective sleepiness scores) for up to two hours. For conditions with no previous sleep, caffeine reduced objective sleepiness for 30 minutes and subjective sleepiness for one hour.⁵⁵ These results were taken during the circadian 'trough' (5:00am to 7:00am) where the effects of fatigue are at their highest.

Single dose, dose-response, slow release

The method of caffeine consumption has also been shown to influence its effects. In general, studies have found a single dose (200 to 400mg) compared to a dose-response relationship (150 or 300mg every six hours) of caffeine to be effective. In the field, it is more realistic that a single dose is how caffeine would be consumed (through an energy drink or two to three cups of coffee).⁵⁵ However, results from previous studies have shown benefits to dose-response, particularly when combined with naps.⁵⁸ Shorter prophylactic naps and small repetitive doses of caffeine maintained performance, mood and alertness during sleep loss, significantly better than no naps or large single doses of caffeine.

The dosage of caffeine has been found to be effective even at lower levels with a high frequency (0.3mg per kilogram, per hour). Importantly, high-frequency low-dose caffeine administration is effective in countering the detrimental performance effects of extended wakefulness. Rising caffeine levels significantly improved wake-dependent deterioration of a number of measures of cognitive performance, particularly at the circadian performance low point.⁵⁹

Furthermore, it has been shown that using a slow release method is a possibility to combat the adverse effects on recovery sleep. A slow release dosage method (administered twice a day: 9:00pm and 9:00am during first 48 hours of wakefulness) can eliminate residual or side effects on recovery sleep, wakefulness and cognitive performance after a long period of sleep restriction (64 hours) and may prove useful for a long work schedule.⁶⁰

Caffeine and sleep inertia

The use of sustained low dose caffeine has also been examined in managing the effects of sleep inertia (cognitive performance impairment, grogginess and tendency to return to sleep immediately after awakening). Caffeine's main mechanism of action on the central nervous system is antagonism (blocking) of adenosine receptors. Adenosine is now accepted to be a potent sleep promoter, so caffeine may have restrained the sleep system.⁵⁵ Therefore, increased adenosine in the brain upon waking may be the cause of sleep inertia. A recent study found inertia to be absent with the use of sustained low doses of caffeine, with caffeine only having a modest effect on sleep during naps. This study suggests caffeine was effective in overcoming sleep inertia, and supports the popularity of caffeine-containing beverages after waking.⁶¹

Counterproductive effects

Caffeine can be effective in improving alertness and performance during sustained wakefulness and sleep deprivation. However, the danger is that it can interfere with recovery sleep, which then makes it counterproductive to managing fatigue. The plasma elimination half-life of caffeine is around five to seven hours.⁶² Regardless of this active period of time for caffeine, the lasting objective and subjective effects can usually only be seen for up to two hours for restricted sleep, or 30 minutes for no sleep.

The implications are that caffeine which is taken close to sleep time can become counterproductive if it is compromising sleep duration and quality.⁵⁴ It has also been shown that sleep obtained within the active half-life of caffeine can affect the amount of total sleep time, slow wave sleep, stage one sleep, sleep onset and sleep efficiency.⁶³ The decision to use caffeine may then be weighed against the immediate benefit of sustaining wakefulness (which may be absolutely necessary) and the potential adverse effects to recovery sleep.⁵⁵

Caffeine and naps

Studies comparing the restorative effects of caffeine (200mg) and naps have shown positive results. Specifically during the mid-afternoon peak of fatigue (during circadian trough) caffeine was effective in reducing fatigue effects and boosting alertness for up to two hours. Combined with napping, caffeine is shown to be even more effective, reducing the fatigue peak completely.⁶⁵ Studies looking at the effects of caffeine compared to napping have been examined in the laboratory and in the field. The results suggest it is the combination of napping and caffeine that provide the best results for maintaining alertness and improving performance, particularly with night-shift workers.^{68, 69}

Comparison to other psychoactive drugs

Compared with other psychoactive drugs (eg. modafinil), caffeine is supported in its use as it is more readily available and less expensive. Caffeine has been shown to maintain performance and alertness during the early morning hours, when the combined effects of sleep loss, and the circadian trough of performance and trough of alertness are apparent. It appears to have equivalent effects for improving performance and alertness during sleep loss in otherwise normal, healthy adults.⁶⁶ However, caffeine withdrawal was associated with reported increases in frequency and severity of headache, and with reports of sleeping longer and more soundly.⁶⁷

Fatigue Audit InterDyne (FAID)

The Fatigue Audit InterDyne (FAID) model has been developed from a series of experimental studies examining the effects of shift lengths, timing of shifts and the importance of work periods in the recent past. The data used to develop and refine the model has been collected over previous decades at a number of national and international facilities. Further, data collected by researchers at the University of South Australia's Centre for Sleep Research has come from laboratory, field and simulator studies in a variety of industries. The development and validation work by these researchers is considerable and has been published in international peer-reviewed journals including:

1. Roach, G. D., Fletcher, A. & Dawson, D. 2004, 'A model to predict work-related fatigue based on hours of work', *Aviation Space and Environmental Medicine*, vol. 75 (3 section 11), A61-A69.
2. Fletcher, A. & Dawson, D. 2001, 'Field-based validations of a work-related fatigue model based on hours of work', *Transportation Research*, Part F4, pp. 75-88.
3. Dawson, D. & Fletcher, A. 2001, 'A quantitative model of work-related fatigue: Background and definition', *Ergonomics*, vol. 44, pp. 144-163.
4. Fletcher, A. & Dawson, D. 2001, 'A quantitative model of work-related fatigue: Empirical evaluations', *Ergonomics*, vol. 44, pp. 475-488.
5. Fletcher, A., Roach, G. D., Lamond, N. & Dawson, D. 2000, 'Laboratory based validations of a work-related fatigue model based on hours of work', *Shiftwork in the 21st Century: Challenges for Research and Practice*, eds. S. Hornberger, P. Knauth, G. Costa, S. Folkard, Peter Land, Frankfurt am Main, Germany.
6. Fletcher, A. & Dawson, D. 1998, 'A work-related fatigue model based on hours of work,' in *Managing Fatigue in Transportation*, ed. I. Hartley, Oxford, Pergamon Press.
7. Fletcher, A. & Dawson, D. 1991, 'A predictive model of work-related fatigue based on hours of work', *Journal of Occupational Health and Safety – Australia and New Zealand*, vol. 13, pp. 471-485.

Defining the scores

Four levels of work-related fatigue scores are defined in the FAID model. Standard fatigue represents fatigue scores up to the maximum score produced by a Monday to Friday, 9:00am to 5:00pm standard work week – this equates to a score of 40. Moderate fatigue scores are considered to be up to 200 per cent of the standard score – this equates to a score of 80. High fatigue scores are between 200 and 250 per cent of the standard score – this equates to a score of 100. Very high scores are those between 250 and 300 per cent – this equates to a score of 120.

Scores between 80 and 100 have been shown to be equivalent to the predicted level of work-related fatigue achieved after 23 to 24 hours of wakefulness. Performance impairment at this level of sleep deprivation has been shown to equate to performance at a blood alcohol concentration greater than 0.05 per cent.

Appendix 8

FRMS fatigue risk mitigation actions

This appendix provides some examples of specific fatigue risk mitigation actions at each of the levels of fatigue risk. Most of the examples provided were implemented at case study sites as part of the initial Alert Doctors Strategy project. We thank the case study sites for sharing their ideas.

Risk level	Controls
Low	<p>No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).</p> <hr/> <p>This level of fatigue risk suggests that a business as usual approach to fatigue management should take place.</p> <p>This does not mean that there is no risk of fatigue. Rather, the ‘green band’ suggests that normal monitoring is needed to identify any instances where fatigue risk might be elevated. Education and training, as well as keeping fatigue ‘on the radar’ are critical here.</p> <p>For instance, a ‘green band’ roster indicates an inherently low risk of fatigue. However, poor sleep between night shifts is a classic example where a green band roster might translate into higher levels of fatigue risk. To that end, normal monitoring includes:</p> <ul style="list-style-type: none"> ● individual sleep wake assessment ● monitoring for symptoms ● monitoring for performance degradation.

Risk level	Controls
Moderate	<p>Initiate moderate fatigue risk mitigation actions</p> <ul style="list-style-type: none"> ● Level 2 and 3 assessment ● Individual controls <hr/> <p>A moderate level of fatigue risk demonstrates that there is a real potential for fatigue to occur. To this end, the actions at this level involve increased monitoring for fatigue-related impairment, as well as a set of preliminary fatigue countermeasures that can be used to reduce the likelihood or mitigate the consequences of fatigue.</p> <p>Key monitoring strategies</p> <ul style="list-style-type: none"> ● Individual sleep wake assessment ● Monitoring for symptoms ● Monitoring for performance degradation. <p>Individual controls – Fatigue countermeasures</p> <ul style="list-style-type: none"> ● Caffeine ● Napping ● Rest breaks ● Adequate hydration and food intake ● Task rotation.

Risk level	Controls
High	<p data-bbox="544 483 991 517">Initiate high fatigue risk mitigation actions</p> <ul data-bbox="544 517 1002 696" style="list-style-type: none"> ● Document with unit director and/or EDMS ● Level 2 and 3 assessment ● Individual controls ● Team-based controls ● Support napping and safe-home policies. <hr data-bbox="539 712 1367 719"/> <p data-bbox="544 725 1326 786">A high level of fatigue risk indicates that fatigue is highly likely to occur, and that risk mitigation strategies are critical to reduce the potential for harm.</p> <p data-bbox="544 801 815 835">Key monitoring strategies</p> <ul data-bbox="544 835 995 936" style="list-style-type: none"> ● Individual sleep wake assessment ● Monitoring for symptoms ● Monitoring for performance degradation. <p data-bbox="544 943 1027 976">Individual controls – Fatigue countermeasures</p> <ul data-bbox="544 976 948 1155" style="list-style-type: none"> ● Caffeine ● Napping ● Rest breaks ● Adequate hydration and food intake ● Task rotation. <p data-bbox="544 1162 1050 1196">Team-based controls – Fatigue countermeasures</p> <ul data-bbox="544 1196 1112 1375" style="list-style-type: none"> ● Declaration of fatigue risk to team ● Task reallocation ● Increased team cross-checking ● Seeking second opinion on critical clinical decisions ● No acting as primary operator in procedural work. <p data-bbox="544 1382 884 1415">Napping controls and safe home</p> <ul data-bbox="544 1415 1091 1516" style="list-style-type: none"> ● Priority access to on-call facility ● Priority access to other napping arrangements ● Access to cab vouchers to get home/back to work.

Risk level	Controls
Very high	<p data-bbox="392 483 1174 539">Intolerable Risk. No individual to work beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.</p> <hr data-bbox="392 562 1174 566"/> <p data-bbox="392 573 1174 663">A very high level of fatigue risk indicates the risks associated with fatigue are critical and the potential for harm is such that work should not continue without significant risk mitigation strategies.</p> <p data-bbox="392 674 663 707">Key monitoring strategies</p> <ul data-bbox="392 712 847 813" style="list-style-type: none"> <li data-bbox="392 712 775 745">● Individual sleep wake assessment <li data-bbox="392 750 683 784">● Monitoring for symptoms <li data-bbox="392 788 847 822">● Monitoring for performance degradation. <p data-bbox="392 824 695 857">Fatigue risk Decision process</p> <ul data-bbox="392 862 1007 963" style="list-style-type: none"> <li data-bbox="392 862 1007 896">● Decision to be made in consultation with clinical director <li data-bbox="392 900 943 934">● No work to continue unless no alternative is viable <li data-bbox="392 938 927 972">● Decision to be documented with district via LWG. <p data-bbox="392 974 743 1008">Specific fatigue countermeasures</p> <ul data-bbox="392 1012 927 1113" style="list-style-type: none"> <li data-bbox="392 1012 831 1046">● Individual controls as per ‘yellow band’ <li data-bbox="392 1050 855 1084">● Team-based controls as per ‘orange band’ <li data-bbox="392 1088 927 1122">● Any additional controls as developed by the unit. <p data-bbox="392 1124 727 1158">Napping controls and safe home</p> <ul data-bbox="392 1162 935 1263" style="list-style-type: none"> <li data-bbox="392 1162 751 1196">● Priority access to on-call facility <li data-bbox="392 1200 895 1234">● Priority access to other napping arrangements <li data-bbox="392 1238 935 1272">● Access to cab vouchers to get home/back to work.

Examples: Individual controls

Caffeine
Energy drinks
Increase sugar snacks
Adjust working temperature and lighting
Adequate hydration and food intake
More frequent assessment of symptoms and fatigue-related behaviours
Work break
Work break (no pager or divert pager)
Quiet rest
Napping
Sleep
Increase physical activity
Increase social interaction
Double check familiar tasks
Defer to a second opinion
Downgrade responsibilities
Increase supervision
Seek phone coverage for several hours
Stand down

Examples: Team controls

Communicate fatigue status at team briefings

Communicate fatigue status in 'fatigue diary'

Communicate fatigue status on daily notice board

Communicate fatigue status to senior nursing staff

Increase cross-checking

Increase supervision

Seek a second opinion

Use of video conferencing/TeleMedicine link to another clinical service provider

Nurse practitioner to see patients triaged as four or five

Emphasis on algorithms and protocols

Task reallocation

Not acting as primary operator

Task rotation

Defer non-urgent cases

Delay decision-making (where appropriate)

Reallocation of patients elsewhere

Shift swaps

Breaking a run of night shifts to obtain recovery sleep

Fatigue leave – stand down

Reallocate duties after on call

Second on call

Night nurse coordination

Safe-home policy (cab vouchers – alternative transport)

Glossary

alertness The opposite state of sleepiness, the state of cognitive and physiological arousal, and responsiveness to environmental/situation conditions.

audit The method of assessing the validity and effectiveness of the strategies and practices adopted at each level of the Defence in Depth (DID) model, with the aim of strengthening the entire model. The aim of Level 4 and 5 in the DID model is to learn lessons when errors and incidents do occur in, order to strengthen the other controls where possible.

controls The strategies and practices (formal and informal) put in place at each level of the Defences in Depth model to manage fatigue and fatigue-related risk. These are the specific risk mitigation actions.

Defences in Depth framework A model utilising multiple layers of defence to manage the occurrence of fatigue-related incidents. It is the major practical or day-to-day aspect of the FRMS and includes tools and controls for monitoring and managing fatigue-related risk. At each level there are opportunities to put in place control strategies to manage the fatigue-related risk. For an incident to occur, each level must have failed in some part to allow the error to pass through.

Level 1 Sleep opportunity; provided at the organisational level, allowed by the roster system.

Level 2 Actual sleep obtained and the extent of actual wakefulness; emphasis is on individual management of time, within rostered opportunity provided.

Level 3 Signs and symptoms of fatigue; observable fatigue-related behaviours and symptoms.

Level 4 Fatigue-related errors; due to the occurrence of fatigue-related behaviours and symptoms.

Level 5 Fatigue-related incidents; the occurrence of errors actualising to incidents.

FAID score A score indicating likely level of fatigue and fatigue-related risk for an individual, given a particular roster system. Four levels of work-related fatigue scores are defined – Standard, Moderate, High, Very High.

fatigue A state of impaired physical and/or mental performance and lowered alertness arising as a result of inadequate restorative sleep. It is a decreased capacity to perform mental or physical work, or the subjective state in which one can no longer perform a task. A state of reduced efficiency due to prolonged or excessive exertion.

Fatigue Audit InterDyne (FAID) A computer based biomathematical modelling software package for assessing fatigue-related risk of planned and actual rosters. The program examines the effects of shift lengths, timing of shifts and the importance of work periods. Factors used are rostered hours and circadian influence.

fatigue countermeasures Individual and organisational fatigue management strategies to reduce the effects of fatigue.

Fatigue Risk Management System (FRMS) An FRMS is an integrated set of management practices, beliefs and procedures for monitoring and managing the risks posed to health and safety by fatigue. It is based in safety management system theory with an emphasis on risk management.

Local Champion Medical officers who are peers and who can dedicate time and effort to working with units in the development of FRMS.

Local Working Group (LWG) The committee with responsibility for overseeing the monitoring and management of fatigue-related risk in the hospital. The local working group (LWG) also plays a vital role in the creation and fostering of a culture in which fatigue risk management is well received and adopted as the norm in the workplace.

mood A sustained affective state, differing from emotions in intensity, localisation and source. It is a generalised affective state, not necessarily as a response/reaction to an external stimulus.

nap Brief sleep episodes taken outside of the major sleep episode. Naps can vary in duration from 5 minutes to 4 hours, with varying restorative benefits depending on duration, time of the day taken, prior wake time and prior sleep.

performance The observable/behavioural manifestation of alertness and sleepiness, and the combination of one's efforts and the results of those efforts.

prior sleep The amount of sleep obtained prior to a specific time (eg. the start or end of a shift).

prior wake The amount of time spent awake prior to a specific period (usually assessed at the start and end of a shift).

risk The potential for harm, a concept that denotes a potential negative impact to some characteristic of value that may arise from a future event. Risks are events or conditions that may occur, and whose occurrence, if it does take place, has a harmful or negative effect.

risk management The process of identifying and managing the factors contributing to risk, errors and incidents, at an individual or an organisational level, and determining how to best handle such exposure.

risk mitigation Covers the efforts taken to reduce either the probability or consequences of a hazard. The Defences in Depth model represents the major risk mitigation strategies employed by an organisation with respect to fatigue and includes tools, strategies and control measures for monitoring and managing fatigue-related risk.

sleep An overall state of psycho-physiological rest, marked by lessened consciousness, lessened movement of the skeletal muscles and slowed-down metabolism. Sleep consists of different neurological stages (non-REM sleep, stages 1-4, and REM sleep), each contributing to the restorative purpose/effects.

sleepiness A state of increased motivation to sleep. Difficulty in maintaining the alert state so that if an individual is not kept active and aroused, they will fall asleep.

subjective fatigue Self-reported levels of feelings of fatigue, assessed on a seven-point scale ranging from 'fully alert, wide awake', to 'completely exhausted, unable to function'.

threshold The limits set for acceptable levels of prior sleep and wake time, FAID score, overtime or other objective measure within the FRMS. Thresholds are based on scientific evidence about sleep, wake, work hours, performance changes, and error and incident frequency.

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