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Current Fatigue Risk Management Strategies for First Responders

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Executive Summary

Objective for CSSP-2018-CP-2366

Our objective is to develop a consensus-based, evidence-informed national Standard on First Responder Workplace Fatigue Risk Management that will provide an approach to systematically prevent and manage workplace fatigue by addressing it in a strategic, coordinated approach, and as part of a broad organizational management framework.

How this milestone supports the objective for CSSP-2018-CP-2366

This milestone will contribute to the development of a Seeds Document that will be used to develop a national Standard, in accordance with CSA Groups' accredited standards development process. This report describes the "Research and Synthesis of Evidence" phase, based on the current practices on first responder workplace fatigue risk management. The objective of this study was to broadly identify current practices pertaining to fatigue risk management for first responder professional groups to inform aspects of the risk management model known as the RACE model (recognize hazards, assess risks, implement controls, and evaluate effectiveness of controls) that will be integrated into a broader management system framework using Plan-Do-Check-Act (PDCA). In addition, this study will identify gaps in existing resources to address first responder fatigue risk management.

Background

First responders are at high risk of suffering from decrements in neurocognitive and physical performance related to fatigue. Such performance decrements endanger not only the personal health and safety of these responders but also the health and safety of the public they serve. Fatigue may also be a precursor to adverse longer-term outcomes. Appropriate management, policymaking, standards, guidance, and research activities can reduce the exposure to these fatigue-related risks and hazards before they pose significant problems during emergency response operations.

Methods

This study aims to examine the accessible content to inform the extent, range, recommendations, and value of available and/or recommended fatigue risk management policies, practices, and procedures for first responder fatigue risk management. Data extraction was completed by conducting both a general online search for key words such as 'fatigue risk management' and 'first responders' (including each of the key groups: 'paramedic/EMS', 'firefighters' and 'police'), and searching key components within the risk management RACE model and other organizational elements. The results of this search were re-organized into a broader management system PDCA framework.

General Findings

From a general Google search using a priori determined keywords and from 86 identified provincial and national first responder associations, compensation boards, health and safety associations, and government websites, we extracted data from 17 publicly available resources (reports, guidelines, standards) documenting procedures, practices, and programs addressing prevention and management of fatigue. There was no single resource currently in practice that comprehensively addressed all elements of a fatigue risk management system for first responders; we found resources addressing individual elements of the PDCA model, particularly Plan and Do elements. Identified Plan activities include work/organizational policies, communication strategies and culture change, fatigue awareness training, monitoring and assessment tools (surveys and a unit hour utilization calculator), and incident reporting strategies. A fatigue cost calculator has been used to calculate the financial burden of fatigue to identify and justify the need for fatigue intervention. Do elements were primarily administrative risk mitigation controls such as work hour restrictions/shift work specifications, organizational recovery time policies, sleep hygiene guidelines, workplace wellness programs, and physical capacity or pre-emptive testing or training. There were general recommendations pertaining to Check and Act elements, including using fatigue calculators (unit hour utilization and fatigue cost) to evaluate the effectiveness of a fatigue control or intervention, and a general recommendation for corrective actions and continuous improvements.

Conclusion

Our review of current programs and practices suggest that there is no comprehensive fatigue risk management system in practice for first responders but there are resources informing the elements of a systematic approach to fatigue risk management. Also, there was very little indication of how fatigue was conceptualized, despite the multifaceted nature of fatigue. A systematic approach to fatigue risk management, addressing all elements of the broad management system PDCA framework remains elusive and desirable.

Introduction

First responders play critical roles in providing and maintaining public health and safety during times of crisis. Police officers, firefighters, and paramedics are exposed to a multitude of fatiguing work demands that may comprise their health, safety, productivity and quality of life. The main objective of this study was to identify and understand the practices, programs, and procedures available to manage the risks and impacts of fatigue. This study provide knowledge about an external environment for strategic planning (Aguilar, 1967; Choo & Auster, 1993).

An evidence-informed Canadian Standard for First Responder Fatigue Risk Management will be developed from the triangulation of this environmental scan of the grey literature, key informant interviews, and a scoping review of the peer-reviewed literature.

Background Information

Fatigue is a multidimensional construct associated with physical, psychological, socioeconomic, and environmental factors (Saito, 1999). We adopt an integrative approach in defining fatigue, considering the phenomena in its various forms. Therefore, fatigue can be broadly described as cognitive (includes mental, central, sleepiness), physical (includes neuromuscular, peripheral, muscular, cardiovascular, exhaustion), perceptual (includes visual or sensory), emotional (includes compassion), and burnout. These categorizations may be induced by physically or mentally demanding tasks and workplace psychosocial demands, may be related to sleep quality and duration, may be related to circadian disruptions, may be related to the individual's capacity, and related to stress arising from exposure to a traumatized individual.

The extent of fatigue within first responder professions is significant. For example, 39% of 379 police officers in the USA reported poor sleep quality (Everding et al., 2016). Forty-six percent of 464 officers in the USA reported chronic physical fatigue (tiredness irrespective of sleep) (Fekedulegn et al., 2017). Thirty-two percent of 747 Spanish police officers reported a high level of burnout; 12.5% and 55.4% of 747 Spanish police officers reported medium and low levels of burnout, respectively (De la Fuente et al., 2013). Also, 37.2% of 6933 American firefighters were screened positive for at least one sleep disorder (Barger et al., 2015). Sixty seven percent of firefighters in the UK reported that the most common stressor causing physical fatigue were associated with demands of fires in both training and real life while wearing self-contained breathing apparatuses (SCBA) (Young et al, 2014). Furthermore, 68% of 60 paramedics in Australia suffered poor sleep quality (Sofianopoulos et al, 2011). Regarding physical fatigue and its impact on continuous chest compressions for CPR, there was a reduction in compression quality over 5 minutes (Ock et al, 2011). Astoundingly, up to 40% of 1101 German paramedics reported high degree of burnout (depersonalization) (Baier et al, 2018).

Operational Terms and Definitions

Fatigue: "Fatigue is the state of feeling very tired, weary or sleepy resulting from insufficient sleep, prolonged mental or physical work, or extended periods of stress or anxiety. Boring or repetitive tasks can intensify feelings of fatigue. Fatigue can be described as either acute or chronic." (Canadian Centre for Occupational Health and Safety, 2017). Another definition, "Fatigue is a process that results in the impairment of wellbeing, capacity, and/or performance as a result of [work] activity." (CRE-MSD Fatigue Workshop, 2012 in Yung, 2016).

The following types of fatigue and their operational definitions have been described elsewhere: Grandjean, 1979; Saito, 1999; Barker & Nussbaum, 2011; Yung et al., 2020.

Cognitive fatigue: involves decrements in human information processing capability due to mental workload. It may be conceptualized as an executive failure to sustain attention to maintain or optimize performance (Holtzer et al., 2010). In this report, we include aspects of sleepiness, sleep quality/duration, arousal, alertness, attention, and both cognitive overload and underload theories of fatigue.

Physical fatigue: involves the inability to maintain physical performance, and can be attributed to metabolic disturbances, failure of neuromuscular transmission, changes affecting the myosin-actin complex, etc. Physical fatigue might also be attributed to changes in function of the central nervous system and impairments might occur in supraspinal areas, spinal areas, and in the muscle afferent system (Behm, 2004). Physical fatigue is associated with a reduction in strength capability (Vøllestad, 1997), changes in motor control (Gates & Dingwell, 2008), and reduced proprioception (Björklund et al, 2000). These fatigue effects might lead to decrease productivity and quality (Hammarskjöld & Harms-Ringdahl, 1992).

Visual/perceptual fatigue: According to Megaw (1995), this manifests as a decline in visual/perceptual performance and/or an increase in visual discomfort. Visual fatigue is a consequence of prolonged visual activity rather than mental workload, which causes changes in arousal level. Task performance may be hindered due to oculomotor strain and effort involved in accommodation and convergence (Ukai & Howarth, 2008).

Emotional fatigue: is the state of feeling emotionally worn out as a result of accumulated stress; emotional exhaustion is a sign of burnout. This includes the term compassion fatigue.

Burnout: is the physical and emotional exhaustion that workers experience due to low job satisfaction, feel powerless, and feel overwhelmed. Burnout is defined by three dimensions: exhaustion, cynicism, and professional inefficiency (Maslach & Leiter, 2016).

Fatigue Risk Management (FRM): As a guiding example provided by Lerman et al. (2012), this may include:

- Management Policy
- Risk Management
- Reporting Processes
- Incident Investigation
- Training & Education
- Internal & External Auditing

First Responder: In Canada, and in the context of the target population for this environmental scan and subsequent standard, the first responder describes three occupations: paramedics, firefighters, and police.

Operational Framework

There is an increasing realization that hours-of-service guidelines alone may not achieve the objective of maximizing alertness (and thus fitness for duty) among individuals performing safety-sensitive work.
Employee alertness depends not only on how many hours worked but also on a variety of other factors including (Lerman et al., 2012):

- **what one does at work;**
- **when one is at work (relative to the individual's circadian rhythm);**
- **whether the work environment promotes alertness or fatigue;**
- **whether there are mechanisms in place to detect excess fatigue;**
- **whether one obtains adequate sleep during time off or uses that time for other purposes;**
- **whether one has a sleep environment that promotes high-quality restorative sleep; and**
- **whether one has emotional, physical, or medical issues that interfere with high quality restorative sleep.**

Consequently, industry and regulators are moving away from hours-of-service standards but toward a comprehensive fatigue risk management system designed to promote alertness, minimize fatigue, identify evidence of excess fatigue, and mitigate either the fatigue itself or its potential consequences (Lerman et al., 2012). An important underlying theme is that a successful fatigue risk management system requires consideration from a wide range of skills, backgrounds, and resources.

Lerman et al., (2012) provides 7 elements of a fatigue risk management system:

1. **Fatigue management policy;**
2. **Fatigue risk management, including collecting information on fatigue as a hazard, analyzing its risk, and implementing controls to mitigate that risk;**
3. **Fatigue reporting system for employees;**
4. **Fatigue incident investigation;**
5. **Fatigue management training and education for employees, management (and families);**
6. **Sleep disorder management; and**
7. **A process for internal and external audits that delivers corrective actions through a continuous improvement process**

Elements identified by Lerman et al., (2012) can be applied into a broader management framework based on the Plan-Do-Check-Act (PDCA) model (**Figure 1**). Thus, the Canadian Standard for First Responder Fatigue Risk Management will be aligned with Lerman et al., (2012) approach while using terminology coherent with broader management systems.

Figure 1: Plan-Do-Check-Act (PDCA) Model (CSA Group, 2013).

Methods and General Results

Data Collection

We performed an environmental scan using a passive approach, which involves casual and opportunistic data collection from industry databases and published documents (Graham et al., 2008).

Resources specific to the prevention and management of fatigue in first responders were obtained through a web-based search of 86 first responder associations of Canada, provincial associations, workers' compensation boards, government websites, and health and safety associations. Additionally, we performed a general Google search using a priori determined keywords including: "fatigue risk management", "fatigue monitoring", "fatigue first responders", "fatigue management policy", "fatigue reporting system", "fatigue incident investigation", "sleep disorder management", and "fatigue management training". This data search was completed between September and December 2019. We contacted these organizations to source additional information not available from the web-based search.

We expanded our initial search to include selected sources from the United States and Australia who are exemplary resources for fatigue risk management available to first responders. We excluded resources pertaining to medical treatment or care for fatigue-related symptoms or disorders, and resources specifically for wildland firefighters, correctional officers, border patrol agents, and air ambulance workers.

Data Extraction

To better facilitate data extraction, we focused on information pertaining to the risk assessment RACE model (recognize hazards, assess risks, control, evaluation) and other organizational elements that can be later re-organized into the broader management system PDCA framework. A data extraction tool developed using Microsoft Excel was used to extract and arrange relevant information into seven categories:

1. General Information
We extracted high-level information, including the occupation (paramedic, police, firefighter, or all first responders), year of publication, and lead author/agency.

2. Scope of Resource for Report
We identified the resource's targeted audience (which first responder group), the description of the resource, and type of fatigue.

3. Recognize Hazards
We extracted information on any strategies, tools, or measures for identifying and monitoring fatigue and the sources or risks that contribute to fatigue.

4. Assess Risks
We identified any risk assessment strategies, tools, or measures that determines the extent or level of fatigue or the risk of any injury, illness, or incident due to fatigue.

5. Implementation of Control
We extracted information on the process of identifying and implementing appropriate controls and identified any fatigue risk mitigation controls.

6. Evaluate Controls
We extracted information on any procedures, processes, or practices related to evaluating the effectiveness of control actions that were taken to reduce fatigue.

7. Other Organizational Elements
We extracted any pertinent information related to work policies, procedures, or practices for planning and implementing fatigue risk management, organizational roles and responsibilities, and continuous improvement strategies for post-implementation controls.

Data Organization

The extracted data were then re-organized as elements of the management system PDCA framework. Policies, procedures, and practices for planning fatigue risk management, roles and responsibilities, and strategies, tools, and or measures of hazard identification and risk assessment strategies were categorized as elements of Plan. Implementation of controls was organized as elements of Do. Procedures to follow-up or evaluate controls were organized into Check. Any continuous improvement strategies were re-organized as elements of Act.

General Results

We extracted data from 17 publicly available resources (reports, guidelines, standards) documenting procedures, practices, and programs addressing prevention and management of fatigue (Table 1).

Table 1. Publicly Available Fatigue-Related Resources for First Responders

Occupation	Source	Title	Summary
Police	CCOHS	OSH Answers Fact Sheet: Police	CCOHS Recommended safe work practices for police.
	CPKN	Fatigue Management	Fatigue Management course available for Policing students and sworn police officers.
	Badge of Life	Compassion Fatigue Train the Trainer	A course for individuals looking to become Compassion Fatigue Educators. This is a peer-led charitable volunteer organization committed to supporting police and corrections personnel who are dealing with psychological injuries diagnosed from service.
Paramedic/ EMS	NASEMSO (Patterson and Robinson)	2018 Fatigue Risk Management Guidelines for Emergency Medical Services	The aim of the guidelines is to mitigate the effects of fatigue with recommendations based on a comprehensive evaluation of the best available evidence related to numerous fatigue mitigation strategies such as using caffeine and napping during shifts. Sample policies surrounding these recommendations are made available within this guidebook.

Table 1. Publicly Available Fatigue-Related Resources for First Responders

Occupation	Source	Title	Summary/Purpose
	NAEMT	Guide to Building an Effective EMS Wellness and Resiliency Program	The guide is a project of NAEMT's EMS Workforce Committee.
	CCOHS	OHS Answers Fact Sheets: Paramedics	CCOHS Recommended safe work practices for paramedics.
	PCC	Operational Stress Injury in Paramedic Services: A Briefing to the Paramedic Chiefs of Canada	The Alberta Critical Incident Advisory Council (ACIAC), provides recommendations for the development, operation, and maintenance of Peer Support best practices for Alberta's first responders (FRs). The document provides information and guidance on the development, maintenance, day-to-day operations, mutual aid, and disaster preparedness and response in Peer Support and critical incident stress management (CISM).
	CSA Group	Z1003.1-18: Psychological health and safety in the paramedic service organization	This Standard provides paramedic service organizations and other key stakeholders with guidance on good practice for the identification and assessment of hazards and management of psychological health and safety (PHS) risks for paramedic service organizations and the promotion of improved psychological health and safety.
	Ontario Emergency Medical Services	Emergency Medical Services Guidance Note #10: Prevention of Musculoskeletal Disorders	The purpose of this Guidance Note is to establish a best practice approach to preventing MSDs in the unique and dynamic work environment of Ontario paramedics.
	SafeWorkSA - Government of Australia	Emergency Services: Guideline for risk managing fatigue	Safe Work Australia's Guide for Managing the Risk of Fatigue at Work (the Guide) provides practical guidance for persons conducting a business or undertaking and other duty holders on how to manage fatigue to ensure it does not contribute to health and safety risks in the workplace.
	Alberta Paramedic Association (APA)	Hours of Work and Rest	Web page provided on Website for the representative body for Alberta's paramedic practitioners, with the mission to support the advancement of the knowledge, skills and health & wellness of the paramedic profession.

Table 1. Publicly Available Fatigue-Related Resources for First Responders

Occupation	Source	Title	Summary/Purpose
Firefighter	Fitch & Associates Consulting	Chief Concerns: Fire Service Fatigue- A Problem You Can't Afford to Ignore	Across North America and the world, Fitch & Associates provides guidance and expertise to help our clients deliver better and more efficient emergency services, accountability and sustainably.
	IAFF and IAFC	The Fire Service Joint Labor Management Wellness-Fitness Initiative (WFI): 4th Edition	The WFI provides a holistic, positive rehabilitation and educational approach to wellness and fitness. In addition, the WFI complements NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments.
All First Responders	Government of Canada	REGDOC-2.2.4: Fitness for Duty: Managing Worker Fatigue	This regulatory document specifies requirements and gives guidance for managing worker fatigue. The target population of this document are professionals working within and alongside high security nuclear sites, including the traditional first responder (police, fire fighters, and paramedics). For the purpose of this regulatory document, managing worker fatigue encompasses measures to manage risks associated with fatigue, including measures to manage the level of fatigue that workers experience at work and to reduce the likelihood and consequences of fatigue-related errors.
	National Response Team	Operational Stress Injury in Paramedic Services: A Briefing to the Paramedic Chiefs of Canada	This document provides an exemplary fatigue management approach that is directed towards emergency response of critical events. The purpose of this Technical Assistance Document (TAD) is to provide an approach for dealing with the unique needs of disaster workers. This TAD guides organizations step by step through the process of developing their own individual fatigue management programs from which they can then develop incident-specific fatigue management plans. To do this, organizations need to assess the types of activities they expect to conduct during a disaster, estimate the conditions under which these activities may be performed, identify the factors typically present at a disaster site that can result in fatigue (i.e., fatigue risk factors), define controls that target these risk factors, and establish evaluation schedules to assess the effectiveness of these controls. While the recommendations in this document can be applied throughout a disaster operation, they are primarily targeted at the operations occurring once rescue efforts have been concluded.

Table 1. Publicly Available Fatigue-Related Resources for First Responders

Occupation	Source	Title	Summary/Purpose
	Brigham Health	Sleep Matters Initiative	The Sleep Matters Initiative (SMI), led by clinicians and researchers at Brigham and Women's Hospital and Harvard Medical School, aims to implement evidence-based clinical treatments for sleep and circadian disorders, and to change the culture of sleep. SMI aims to improve health, safety, performance and well-being of people worldwide by translating cutting-edge research on sleep and circadian rhythms into practice. Brigham Health offers a sleep health education and sleep disorders screening program tailored for firefighters.
	CCOHS	OSH Answers Fact Sheets: Rotational Shiftwork	Resource links from both Police and Paramedic Fact Sheets, describing occupational health and safety information regarding shiftwork including its effects and suggested organizational approaches.

Results: PLAN

Established Policies or Procedures

The Implementation Guidebook for the 2018 Fatigue Risk Management Guidelines for EMS recommended that employers should develop work policies to support fatigue risk management, specifically for paramedic/EMS personnel. Additionally, this guideline recommends that employers should plan to establish policies and initiatives surrounding healthy lifestyle promotion to address fatigue (Patterson & Robinson, 2018). This document also provides sample policies to apply in the workplace.

A regulatory document published by the Government of Canada, pertaining to professions that involve working in potentially safety-critical environments and shift work, identified policy recommendations for fatigue management planning. They recommended establishing, implementing and maintaining a process to identify, evaluate, and manage scenarios where workers have temporary or ongoing fatigue-related limitations that may make them incapable to competently and safely perform their assigned duties. Important to fatigue recognition, this process shall address:

- Expectations for self-reporting when workers believe they are fatigued to competently and safely perform their assigned duties;
- Actions for workers to take if they are experiencing a temporary or ongoing circumstance(s) or condition(s) that increase their risk of experiencing fatigue at work; and
- Actions for supervisors to take if they believe, through self-reporting or observation, that a worker may be unable to competently and safely perform his or her assigned duties because of fatigue (Government of Canada, 2014).

Having concrete work policies and procedures, and outlining ownership or responsibilities, is an initial step to a larger-scale fatigue management process (Patterson & Robinson, 2018). This will set the groundwork for an adaptable and effective management system to address fatigue.

Fatigue Identification and Monitoring Strategies

The review of existing resources suggests various risk factors relating to fatigue in first responder work.
Australia's SafeWorkSA Emergency Services guideline (SafeWorkSA, 2016) provides a Risk Management Chart that considers the following fatigue indicators:

- **Working hours per week;**
- **Working hours per shift/day;**
- **Shift type;**
- **Breaks;**
- **Level of physical demands of work;**
- **Level/duration of exposure to hazardous substances and noise; and**
- **Duration of sleep and family time**.

The National Response Team (United States of America) developed recommendations directed towards emergency response of critical events but may be viewed as an exemplar source for fatigue risk management. This source recommended using a historical review of risk factors over a specific period to determine the nature of incidents and to help identify potential risk factors. The historical review can be helpful in encouraging organizations to focus on lessons learned after previous incidents and modify their plans based on those lessons (National Response Team, 2009).

As an example, the National Response Team guideline states that fatigue risk factors are categorized into six groups. For each of these groups, lessons learned from past emergency operations help guide procedures for future operations (National Response Team, 2009). The organization should establish a process for assessing the significance of each risk factor and setting priorities for the use of resources. These groups or leading indicators are similar to those found in daily first responder activities and therefore, they need to be considered as indicators for fatigue risk management.

1. Work Hours and Rest Periods – Describe the work hours, work rotations, and rest periods that are characteristic of the types of operations the organization has conducted in the past and anticipates conducting as part of future disaster efforts. For example, a policy might state that workers have a minimum of 10 hours of rest time in a 24-hour period, and 48 hours time off after 14 consecutive days of work.
2. Site Conditions – Describe the range of conditions previously encountered by the organization's responders while performing disaster operations and that are likely to be encountered in the future (e.g., extent of devastation, including infrastructure damage, population displacement, and security of worksite).
3. Living Conditions – Describe the nature of accommodations generally provided to workers during previous disaster operations (e.g., hotel/motel, trailers, tents, food service or MREs, sanitary facilities, and recreational opportunities).
4. Nature of Work – Describe the various types of work (e.g., collection of containers, tarping roofs, collection of white goods, and oil spill cleanup) performed by the organization in previous disaster operations and, considering any mission changes, are likely to be performed by the organization at future disaster operations.
5. Management and Administrative Support – Describe the management and administrative support functions and services provided at previous disaster operations (e.g., contracting, financial services, and clerical support).
6. Emotional Stress – Describe the types of stressful situations previously experienced by the organization's disaster workers and are likely to be experienced at future events (e.g., exposure to bodies or seriously injured people, severe devastation, and/or homeless victims).

Recognizing fatigue risk factors and understanding trend data may assist workers and employers to detect and monitor fatigue. Furthermore, these factors can serve as triggers for downstream assessments and as controls.

Since the above resource developed by the National Response Team is directed towards emergency response of disaster-related incidents, profession-specific factors and work demands should be considered when interpreting these policies, programs, or procedures for day-to-day first responder activities.

The contribution of each fatigue risk factor (or leading indicator) to the overall fatigue risk will vary among first responder professions, incidents, and individuals. These factors should be assessed when developing an incident-specific plan. The organization should plan a process for assessing each fatigue risk factor and its impact, as a component of the operational program. For example, the Risk Management Assessment Tool, as demonstrated by the National Response Team Guidance for Managing Worker Fatigue during Disaster Operations, can be used to determine the potential contribution of each risk factor to the overall risk for workers (National Response Team, 2009).

The review of existing resources suggests the importance of identification of fatigue, evaluation of the risk, and monitoring strategies as an essential aspect of fatigue risk management.

Communication Strategies and Culture Change for Fatigue Recognition and Reporting

Open and effective communication strategies within an organization are vital to report and identify any work-related issue. Organizational-wide communication strategies are usually informed by organizational culture, awareness training, and incident reporting process.

An ad-hoc committee provided recommendations to the Paramedic Chiefs of Canada for programs that address occupational stress injuries, including compassion fatigue, burnout and other dimensions of fatigue. They highlight that championing the issue of occupational stress within the organization should involve an internal working group. The internal working group provides education on occupational stress injuries and conducts or performs surveys, analyses, audits, benchmarking, and monitoring. For this to be achieved, it is important that organizations communicate to paramedics not to merely 'suck it up' but rather report signs and symptoms (PCC, 2014).

The suggested strategies contribute to the communication of fatigue-related issues and results in the identification of risk factors and consequently reduction of fatigue. By employing procedures and methods of communication such as those described, fatigue hazards and risk factors may be recognized and addressed rather than simply accepted as 'part of the job'.

Incident Investigation and Reporting

A regulatory document developed by the Government of Canada focused on managing fatigue in nuclear response forces and surrounding first responders. They recommend that:

> *"Organizations shall identify and resolve problems related to worker fatigue. When an act or omission by a worker may have caused or contributed to a safety significant incident, organizations shall record the work schedule of workers directly involved, when known, for at least one week prior to the incident. These data shall be assessed periodically to determine the effectiveness of the limits on hours of work and recovery periods. The incident analysis team should consider, and record fatigue-related factors of the workers directly involved (e.g., work schedule, sleep obtained prior to the incident compared to sleep normally obtained, consecutive hours awake at the time of the incident), and should determine if performance was consistent with the effects of fatigue. Organizations should capture this information as part of the incident report."* (Government of Canada, 2014).

This suggests that recording fatigue-related data should be included in any incident investigation and reporting. Organizations may incorporate this into their overall occupational health and safety management system.

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Risk Assessment Strategies

To assess the state of fatigue at both individual and organizational levels several risk assessment tools are recommended. Some examples of measurements include but are not limited to Unit Hour Utilization (UHU), Fatigue Cost Calculator tool, and Fatigue Risk Management Assessment Tool. Additional forms of assessment are questionnaires/surveys. The review of literature provides a comprehensive list of risk assessment tools.

Unit Hour Utilization (UHU)

In the context of the firefighter performing physically demanding duties on the job, determining physical fatigue is quite complex. According to Fitch & Associates Consulting, one traditionally used method of measuring fatigue is a construct of workload known as Unit Hour Utilization (UHU). UHU is calculated as a percentage of time during a shift that the firefighter is assigned to an incident.

For example:
If during a 24-hour shift, an engine company responded to 10 calls, and the average time from dispatch to returning to service was 43 minutes,

$$\text{UHU} = \frac{avg\ time * number\ of\ calls}{total\ number\ of\ mins\ in\ a\ shift} \qquad \text{UHU} = \frac{43\ mins * 10\ calls}{1440\ minutes} = 30\%$$

Alternatively, paramedic UHU is calculated by dividing the number of EMS transports by the number of hours a unit is in service (Fitch & Associates, 2019).

Fatigue Cost Calculator

The cost of fatigue within an organization may be used for identifying and justifying the need for fatigue intervention. An important method and resource that may be used to achieve assessment of fatigue, for example, is a Fatigue Cost Calculator. The National Safety Council in collaboration with Brigham and Women's Hospital, developed an online tool, where employers can estimate the cost of fatigue on their bottom line. The calculator estimates how much of the burden can be avoided when a fatigue risk management program is implemented in the workplace (Brigham Health, 2019). This resource could also be utilized as part of a follow-up or evaluation activity, to assess the performance of implemented interventions and risk control actions.

Incorporating a fatigue assessment and evaluation strategy such as UHU or the Fatigue Cost Calculator may be an important means for early detection of fatigue in first responders. As compounding factors lead to fatigue, the decline of performance that is possibly indicative of worker fatigue may be detected through a time-based measurement such as UHU. This can be done by comparing the calculation to the "generally accepted guideline for determining worker threshold" within a 24-hour shift: 25-30% UHU (Fitch & Associates, 2019). If applied correctly, this measurement could trigger downstream compensatory controls for first responder fatigue risk management such as the application of recovery strategies or emergency response plan modifications to optimize health and performance output.

The UHU method of assessing fatigue does not directly measure or determine root cause (fatigue risk factors) nor effect (fatigue outcomes).

> *"While UHU is a useful measure, its meaning is often misconstrued. There are no set industry standards for UHU, although it is generally accepted that the guideline for determining worker threshold is approximately 25 or 30 percent UHU. The question is, how much time during a shift should a firefighter be performing work-related (emergency and non-emergency) activities, and how much time should be true "down-time"? While the answer to that question is still not known, what is clear is that fire service leaders need to be aware of how they are measuring UHU (and why) before they compare their numbers to external standards or other departments that may use different methods or have different goals in mind—and also keep in mind that UHU standards were recommended to ensure reliability, not to address fatigue"* (Fitch & Associates Consulting, 2019).

According to the International Fire Chiefs Association, this measure has been applied as a cost evaluation or billing rate tool, having a secondary purpose as a tool for financial justification of implementing a fatigue control. A barrier to effectively implementing UHU as a form of fatigue assessment is the need to tailor this measurement in ways that are realistic to the first responder profession and corresponding work; tasks involved in emergency work are largely unpredictable and uncontrolled, both between calls and shifts. Other considerations include the environment in which they work, the expected and probability of physical and/or mental demands, and individual characteristics, etc.

Fatigue Risk Management Assessment Tool

Fatigue risk management assessment tools detect aspects of the work or identify individuals who may be experiencing high severity of fatigue, and thus, can be targeted for fatigue management strategies or controls.

Specifically intended for guiding organizations to implement a system for managing worker fatigue during disaster operations, the National Response Team (NRT) provided a Technical Assistance Document based on the Plan-Do-Check-Act model, which included a Fatigue Management Risk Assessment Tool. This risk assessment tool includes a selection of fatigue risk factors, categorized as "stressors". A weight factor and selection of exposure factors are provided, resulting in a numeric total corresponding to a "Risk #", and appropriate "Corrective Action Plan" to address fatigue risk. (National Response Team, 2009). Although this tool is suggested for disaster operations, similar principles could be applied for other first responder scenarios.

Due to the nature of their work, first responders are required to act at a moment's notice and must be prepared both mentally and physically to perform their job functions. A method of assessing fatigue status such as a fatigue risk management assessment tool may be able to help determine 'fitness for duty' of these individuals. Once relevant fatigue indicators are determined, this tool can equip both the front-line individual and the organizational management system with a means of identifying fatigue in first responders before they may be exposed to fatiguing risk factors in an emergency. After the identification of significant fatigue, controls may be applied to combat fatigue and to prevent fatigue-related safety risks.

Fatigue risk management assessment tools may require significant modifications and continuous revisions to ensure applicability for different first responder professions and their respective situational contexts.

Questionnaires or Surveys for Fatigue Assessment

Questionnaires or surveys maybe used for the unique first responder occupation and should include a battery of questions or items that help the individual and management to assess the levels of fatigue.

EMS Fatigue Risk Management Guideline recommends "using fatigue/sleepiness survey instruments to measure and monitor fatigue in EMS personnel" (Patterson and Robinson, 2018). The International Association of Firefighters (IAFF) and International Association of Fire Chiefs (IAFC) recommend firefighters undergo screening for sleep disorders as part of their annual medical evaluation. Specific validated screening tools include the Berlin sleep questionnaire and Epworth Sleepiness Scale (IAFF and IAFC, 2018). If individuals are experiencing levels of fatigue that may be to the detriment of their work performance, fatigue/sleep surveys may help justify rest periods to protect both the first responder and the public whom they are servicing from fatigue-related errors.

The results of our literature review (Milestone 3) provides an extensive review of potential risk assessment tools and techniques for first responders.

Results: DO

Work Hour Restrictions/Shift Work Specifications

The review of existing resources identified a number of specifications and restrictions to reduce risk of fatigue in first responders. We provide examples of organizational-level information that is available regarding hours of work. The lists below summarize examples of information and recommendations on work hour restrictions and shift work specifications, targeting either individual or multiple first responder professions:

Work hour recommendations for paramedics

CCOHS website suggests paramedics to follow a recommended shift work pattern and be aware of the fatigue and other hazards associated with shift work (CCOHS, 2017). Other guidelines and resources provide additional guidance as follow:

- EMS personnel should work shifts shorter than 24 hours in duration (Patterson and Robinson, 2018).
- A paramedic service organization providing good work/life balance should be able to state that worker fatigue due to shift patterns and long shift duration is monitored and addressed (CSA Group, 2018).
- The Alberta Paramedic Association (APA) indicate that rural paramedics follow a Core-Flex model, which is an extended service schedule of 96 hours or more.

In the opinion of the APA:

> *"In an effort to reduce the liability of fatigue, EMS operations have started to implement fatigue management policies. These management policies are based on a "time on task" formula; which focuses on items such as emergency calls and inter-facility transfers"*

(Alberta Paramedic Association, 2019).

Work hour recommendations for police

Similar to paramedics, CCOHS suggest police departments to follow a recommended shift work pattern and protect workers from the hazards associated with shift work (CCOHS, 2017) The Government of Canada's regulatory document, "Fitness for Duty: Managing Worker Fatigue" suggests:

- Establishing limits on hours of work and recovery periods
- For the broad population of workers, organizations shall document and implement limits on hours of work and recovery periods that:

1. Provide sufficient time for sleep;
2. Restrict consecutive shifts to limit the build-up of sleep debt;
3. Provide sufficient time off to allow for recovery from sleep debt; and
4. Limit average weekly hours as a safeguard against cumulative fatigue

- Organizations shall document the rationale that justifies their limits on hours of work and recovery periods, and the rationale shall be based on scientific principles and knowledge.
- Organizations may apply different limits on hours of work and recovery periods to different workers in a graded manner that commensurate with risk.
- Schedule safety-critical tasks outside of peak times for fatigue (especially between the hours of 2 a.m. and 6 a.m.) when possible.
- Rotate workers between tasks of varying cognitive and physical workloads when possible.
- Organizations shall ensure that the hours worked do not exceed the following limits:

1. 16 hours in a 24-hour period.
2. 28 hours in a 48-hour period.
3. 60 hours in a fixed 7-day period OR 120 hours in a rolling 14-day period.
4. 54 hours per week on average over a fixed period not exceeding 13 weeks OR a rolling period not exceeding 18 weeks (Government of Canada, 2014).

Work hour recommendations for firefighters

Implementing optimally structured shifts or work hour specification guidelines could prevent and mitigate first responder fatigue caused by long hours on the job. When applied, these principles would encourage better work-life balance, recovery, and quality of life, which can contribute to a healthier overall sense of well-being as well as reduce fatigue and mental exhaustion.

Some departments try to offset the impact of fatigue by rotating firefighters through multiple stations or apparatus. This is especially popular in stations that have EMS transport units and ALS fire units. For instance, in some areas, firefighter/paramedics typically work 12 hours on an EMS unit and 12 hours on a fire suppression unit during each shift. Other departments assign personnel to stations but not to specific companies, allowing them to rotate from busier units (such as ambulances or engines) to slower units (truck or rescue companies). Another example is to rotate firefighters between busy and slow units every few months, or annually. This would not address the day-to-day impacts of fatigue at the busier stations but may help alleviate some of the long-term health effects and stress caused by several years of sleep deprivation. Some services offer multiple schedules—many fire departments that traditionally had only 24-hour shifts have now implemented some 12-hour schedules. While these changes were typically made to adjust to rising call volumes during the day, "peak-time" units also offer personnel a chance to get a good night's rest at home every night. Having a selection of different shift options may help employees find a schedule that best fits with their personal lives and allows them to get proper rest (Fitch & Associates, 2019)

In general, the CCOHS suggests that both police and paramedic workers follow a recommended shift work pattern and protect themselves from the hazards associated with shift work (CCOHS, 2017). CCOHS Fact Sheets focused on paramedic and police health and safety have general recommendations on shift work.

It is important to understand the barriers, challenges and limitations of using these suggested guidelines. As highlighted by CCOHS, guidance for ideal shift patterns in first responders has been disputed (CCOHS, 2017). An extensive fatigue impact study conducted by APA to explore the associated health effects of the Core-Flex staffing model. Their study identified significant barriers to the effectiveness of the work hour specification elements under the Core-Flex model.

Fatigue Management Policies:
"These policies fail to consider the total time a paramedic is awake within its "time on task" calculation. The result is that paramedics are awake for an extended period of time prior to being assigned a task that can be calculated towards their "time on task" clock. Due to this, practitioners have reported being awake for greater than twenty-four hours but haven't accumulated enough hours to go out of service for fatigue. Additionally, practitioners have reported micro sleep during patient care or while driving the ambulance.

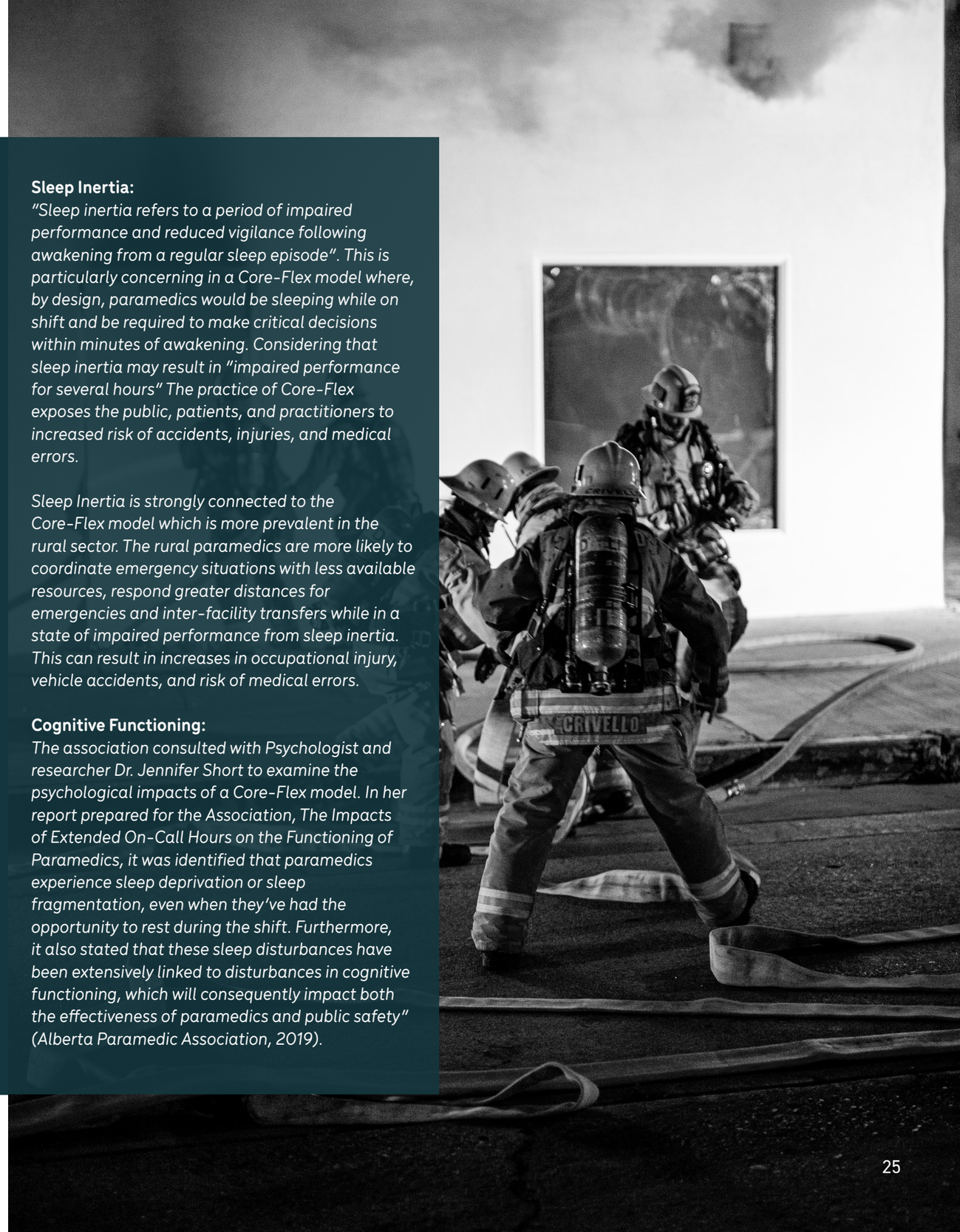
When the criteria are met within current fatigue management policies, ambulances within our communities are then "out of service" for set periods of time requiring ambulances to respond great distances from other communities who may also be subject to the Core-Flex model. To circumvent the impact that fatigue management policies have on our EMS coverage, fatigue management policies have incorporated a strategy where paramedics who are high on "time on task" hours are being reserved for critical patients and emergency calls. In essence, this results in the requirement of fatigued paramedics to provide care to patients (people of Alberta) who require the highest level of critical thinking and medical interventions.

There is no consideration within the Core-Flex model and the fatigue management policies for paramedics to properly prepare for each shift; determine regular work hours; establish a regular sleep cycle; or address sleep fragmentation and sleep deprivation.

Sleep Inertia:
"Sleep inertia refers to a period of impaired performance and reduced vigilance following awakening from a regular sleep episode". This is particularly concerning in a Core-Flex model where, by design, paramedics would be sleeping while on shift and be required to make critical decisions within minutes of awakening. Considering that sleep inertia may result in "impaired performance for several hours" The practice of Core-Flex exposes the public, patients, and practitioners to increased risk of accidents, injuries, and medical errors.

Sleep Inertia is strongly connected to the Core-Flex model which is more prevalent in the rural sector. The rural paramedics are more likely to coordinate emergency situations with less available resources, respond greater distances for emergencies and inter-facility transfers while in a state of impaired performance from sleep inertia. This can result in increases in occupational injury, vehicle accidents, and risk of medical errors.

Cognitive Functioning:
The association consulted with Psychologist and researcher Dr. Jennifer Short to examine the psychological impacts of a Core-Flex model. In her report prepared for the Association, The Impacts of Extended On-Call Hours on the Functioning of Paramedics, it was identified that paramedics experience sleep deprivation or sleep fragmentation, even when they've had the opportunity to rest during the shift. Furthermore, it also stated that these sleep disturbances have been extensively linked to disturbances in cognitive functioning, which will consequently impact both the effectiveness of paramedics and public safety" (Alberta Paramedic Association, 2019).



Organizational Recovery Time Policies or Guidelines

The review of existing resources suggests implementing strategies including organizational recovery time policies, sleep hygiene guidelines, and company benefits or wellness programs aiming at fatigue recovery or mitigation. First responder organizations may implement specific policies, programs or guidelines on recommended or mandatory rest durations or conditions between working hours/shifts. For example, the APA refers to Alberta Employment Standards, which states that employees are entitled to breaks (at least 30 minutes) during every 5-hour work period. In addition, the 2018 Fatigue Risk Management Guidelines for Emergency Medical Services suggests, "providing EMS personnel the opportunity to nap on duty is best demonstrated with a written policy" (Patterson and Robinson, 2018).

Targeted for paramedics, Fitch & Associates Consulting recommends the following:

"When shifts greater than or equal to 24 hours occur or are necessary, administrators should consider a policy that gives EMS personnel permission to call a "time-out" and rest for a reasonable period. Policies requiring employees to rest for a certain period prior to reporting for work may diminish some of the department's liability should an incident occur but are typically difficult to enforce to prevent fatigue. They also raise issues over how much control an employer can have over the off-duty activities or family life of an employee" (Fitch & Associates Consulting, 2019).

Fatigue Awareness and Training

It is essential for organization to provide fatigue awareness training to their employees. The review of existing resources identified several fatigue awareness and training programs. The following paragraph provides some examples.

The Compassion Fatigue Train the Trainer course provides the tools and resources to educate workers on the basics of compassion fatigue and vicarious trauma and manage the challenges of working in high-stress workplaces. It is suggested that this kind of education is the foundation for ensuring a healthy and efficient team (Badge of Life, 2019). Badge of Life, a peer-led charitable volunteer organization, is committed to supporting police and corrections personnel who are dealing with psychological injuries (Badge of Life, 2019).

A fatigue awareness online course provided by the Toronto Police Service, sponsored by Canadian Police Knowledge Network (CPKN, 2019), is targeted toward policing students and currently active officers. The key deliverables of this course include:

- Appreciate the effects of fatigue;
- Restate how chronic sleep deprivation affects an individual's ability to perform tasks;
- Demonstrate a working knowledge of fatigue management strategies;
- Contrast the strategies that a member who is suffering from fatigue could employ; and
- Demonstrate sleep countermeasures for the two most common sleep disorders.

The regulatory document, REGDOC-2.2.4: Fitness for Duty: Managing Worker Fatigue, developed by the Canadian Nuclear Safety Commission, covering professions that involve working potentially safety-critical exposures and shift work, discussed the comprehensive topics in which fatigue training should cover. The following is stated:

"Training and education about fatigue and measures for managing risks associated with worker fatigue should address the following topics":

- Causes, risks and consequences of fatigue: For example, effects of fatigue and circadian rhythms on alertness and performance; importance of sleep and strategies to maximize the benefits of recovery opportunities; sleep disorders and their treatment; symptoms of fatigue; measures to minimize the effects of fatigue; commuting)
- Measures for managing worker fatigue: For example, authorities, accountabilities and responsibilities for managing worker fatigue and controlling hours of work; process to follow when a performance impairment due to fatigue is suspected)
- Regulatory requirements related to fatigue and hours of work

Finally, Patterson and Robinson's (2018) Implementation Guidebook for the 2018 Fatigue Risk Management Guidelines for Emergency Medical recommends that:

EMS personnel [should] receive education and training to mitigate fatigue and fatigue-related risks [delivered] during new employee orientation (onboarding) and every two years [by administrators]. A sample policy is available within this guidebook.

Sleep Hygiene Guidelines

In addition to training, first responder organizations may provide sleep hygiene guidelines on the "rituals and behaviors that help people fall asleep and stay asleep" (NAEMT, 2019).

NAEMT acknowledges that strategies suggested for good sleep hygiene "can be difficult for EMS practitioners, especially those who work 24-hour shifts" (NAEMT, 2019). This may be due to the times of the day in which first responders may be off work, when broad daylight interferes with restful sleep. Sleep hygiene guidelines are at the discretion of the worker themselves, but the organization can support these habits.

Recommended practices for good sleep hygiene include:

- Avoiding caffeine close to bedtime;
- Ensuring adequate exposure to natural light;
- Limiting screen time/turning off your cell phone;
- Exercising during the day, and
- Sleeping in a quiet, dark room.

Physical Capacity/Pre-emptive Testing and Training

First responder professions often require physical capacity testing and training due to the physical demands of the job. These programs may be used to pre-emptively determine the physical fatigability of individuals entering or existing in these professions and prepare these individuals for the demands related to fatigue. Physical conditioning may be used as an early indicator of low tolerance for the fatigue-inducing factors that may exist at a job. These physical fatigue assessments may help first responders to avoid long-term injuries and possibly prepare and prevent job errors due to fatigue.

Research reveals the need for high levels of physical fitness to safely perform the necessary duties of the fire service (IAFF and IAFC, 2018). Insufficient muscular endurance will limit the amount of time that a firefighter can continue to work effectively. Poor endurance can also precipitate injury, because fatigue may affect optimal movement patterns. For instance, the muscles of the trunk help support the low back during sustained exertions, which implies that endurance of these muscles is critical. Because many back injuries occur when the spine is flexed, extended and/or rotated, the ability to resist these movements under load and over extended periods is also essential to the prevention of low back pain and injury (IAFF and IAFC, 2018).

Preparing the first responder for factors that will put them at heightened risk of fatigue is essential to primary prevention. Physical testing, specifically pre-emptive, may allow the worker and employer to determine whether they are ready for the physical demands in the field. The fitness protocol assessments are arranged to minimize the effect of fatigue on subsequent performance, mitigate injury risk, and standardize the protocol so progress can be monitored over time (IAFF and IAFC, 2018). Testing will also facilitate identification and monitoring of indices that may raise awareness to first responder risk of fatigue and injury.

Physical capacity testing may include strength, cardiorespiratory, flexibility, or other types of physical dimensions relevant to prepare first responders. It is generally recommended by the International Association of Fire Fighters (IAFF) and International Association of Fire Chiefs (IAFC) to implement fitness protocols based on the latest research and designed to meet the unique demands of each fire fighter. All uniformed personnel should understand that the goal of the Wellness-Fitness Initiative (WFI) fitness assessment is solely to inform improvements in personal fitness (IAFF and IAFC, 2018). This application of physical fitness testing is also important for informing both the individual and management of strength and endurance, including the tendency or resistance toward fatigue. The IAFF and IAFC provided a model for proper implementation of fitness programs in the fire service within The Fire Service Joint Labor Management Wellness-Fitness Initiative. They state that the fitness capacity testing program is important because:

"Research has shown the need for high levels of aerobic capacity, power, muscular strength and endurance, mobility and flexibility, whole-body coordination and control, and favorable body composition to perform safely and effectively on the fire ground. High levels of physical capacity and body awareness are essential in maintaining the wellness of our uniformed personnel. Fitness must be incorporated into the overall fire service philosophy. While assessing uniformed personnel's current fitness level is an important part of developing an individualized fitness program, assessment is not, in itself, a fitness program" (IAFF and IAFC, 2018).

It is important to highlight that the source (WFI) provided by the IAFF and IAFC is not a Standard and strongly suggests that under no circumstances the norms established by fire departments should not be used to establish a standard that, if not met, may result in punitive action.

The application of any physical pre-emptive fitness protocol assessments must trigger additional considerations (IAFF and IAFC, 2018). These may include monitoring potential health indicators such as:

- Onset of angina or angina-like symptoms;
- Signs of poor perfusion: light-headedness, confusion, ataxia, poor pallor, cyanosis, nausea, or cold, clammy skin;
- Failure of heart rate to increase with increase in exercise intensity;
- Participant requests evaluation to stop;
- Physical or verbal manifestations of severe fatigue;
- Joint or muscle pain that becomes aggravated with exercise; and
- Failure of the testing equipment.

This review did not find any specific sources addressing fatigue and capacity testing specific for police and paramedic professions.

Work Environment/Facilities and Equipment

Providing the appropriate facilities and environment can help first responders rest and recover from fatigue during or between calls. Strategies such as modifications to the equipment and providing rest areas may be impactful in preventing and reducing both acute and chronic worker fatigue.

The Ontario Emergency Medical Services Section 21 Sub Committee suggested that engineering controls to address muscular fatigue should include modifications to the vehicle, equipment or processes that eliminate or reduce the exposure (any modifications must still meet applicable vehicles or equipment standards from the Ministry of Health and Long-Term Care). Paramedic services should consider principles of Musculoskeletal Disorders (MSD) prevention including a systems-based approach that considers interactions between people and components of the work system, such as tasks, equipment, workspace, work organization, and the environment. According to Ontario Emergency Medical Services Section 21 Sub Committee, 2017, prior to introducing controls to limit exposure to MSD hazards, two best practices should be considered:

1. Engineering controls should be attempted before administrative controls when possible as adherence to administrative controls can be difficult in high stress situations, like those faced by paramedics.
2. To facilitate adoption of an intervention, paramedic services should:

a. Demonstrate the ergonomic advantage to paramedic health and well-being, and/or to patient care that is afforded by the intervention;
b. Involve paramedics in trialing and testing of equipment, and related decision-making processes;
c. Involve workplace Joint Health and Safety Committee (JHSC) or the Health and Safety Representative (as appropriate to the workplace) in the process; and
d. Provide appropriate training, including information, instruction and supervision as required by the Occupational Health and Safety Act.

A sleep warning device (a type of personal protective equipment) could be used for long distance driving. This driver-worn device fits over the ear and sounds an alarm when the wearer flexes their neck past a certain angle that may indicate that the individual has fallen asleep. A large EMS Agency based in West Virginia, USA, named JanCare, utilizes these sleep warning devices, and recommends them as a tool for preventing fatigue-related motor vehicle accidents (NAEMT, 2019).

Additionally, guidelines regarding work environment fatigue control strategies for general shift workers were provided by CCOHS. These suggestions were not specifically targeted at first responders, but the general shift worker professional (CCOHS, 2017). These include:

- Provide rest facilities where possible. Whenever a person must remain at work after a night shift to attend a meeting or a training session, providing rest facilities is advisable. When a night worker is "on call" and must remain in the building, it is advantageous for this person to be well rested rather than tired and bored.
- Provide healthy cafeteria services so a balanced diet can be maintained. The nutritional needs differ between day shifts and other shifts because of circadian rhythms. Provide educational and awareness materials on the benefits of eating a balanced meal.
- Consider offering facilities for social activities with the needs of the shift worker in mind. Recreational opportunities are often minimal for workers on "non-day/night" shifts.
- Consider access to quality day-care for shift workers' children. Some strain on all family members would be alleviated.

Firefighters are required to perform physically strenuous work duties while wearing heavy and bulky personal protective equipment. This equipment may be designed to reduce physically fatiguing demands.

To implement work environment/facilities/equipment related changes for the improvement of employee fatigue, work policies or procedures informing their appropriate usage may be necessary to maximize their benefits. For example, policies may define 'silent zones', which are napping areas that allow for uninterrupted rest. Information regarding equipment that may be used to address fatigue in firefighters and police officers was not found.

Workplace Wellness Programs and Guidelines for Fatigue

Organizational-level implementation and support of wellness initiatives towards fatigue risk management may provide improved access to fatigue control strategies and resources for first responders. Taking action towards helping frontline workers to improve their overall health and wellness, contributes positively to fatigue risk management and the overall well-being of the first responder.

The Guide to Building an Effective EMS Wellness and Resiliency Program by NAEMT provides suggestions for fatigue-related workplace wellness programs. The guide suggests establishing policies and initiatives that promote a healthy lifestyle such as smoking cessation, weight loss programs, and opportunities to exercise (NAEMT, 2019).

Controlling the Risk of Fatigue

Organizations require a strategy to implement changes to control the risk of fatigue. This is an essential aspect of risk management. Patterson and Robinson (2018) suggests "modern approaches combine limits on shift duration with other strategies to comprise a comprehensive fatigue risk management program or system". This means that fatigue risk management should be an approach that considers multiple aspects and avenues of fatigue mitigation.

CSA Standard Z1003.1-18: Psychological Health and Safety in the Paramedic Service Organization, the following were suggested as characteristics that allow a paramedic service organization to maintain good work/life balance:

- The effects of shift work and fatigue on the workers is recognized;
- Worker fatigue due to shift patterns and durations is monitored and addressed; and
- [Workers have] access to training, resources and tools surrounding vicarious (secondary) trauma, compassion fatigue, burnout, grief, and moral conflicts.

These elements indicate that fatigue management is part of an organizational process that must be recognized and owned by leadership and/or decision-makers.

Supporting a system of controls for fatigue risk management, the Government of Canada's REGDOC-2.2.4: Fitness for Duty: Managing Worker Fatigue suggests that:

> "Organizations should define and implement a range of measures to manage risks associated with fatigue, including those to manage the level of fatigue workers experience at work and to reduce the likelihood and consequences of fatigue-related errors."

In addition, this resource suggests:

- Allowing rest periods or an opportunity to sleep with appropriate conditions defined (for example, turnover of duties, acceptable location(s), and duration);
- Nurturing an environment that encourages self-reporting when workers believe they are too fatigued to perform their duties competently and safely (for example, freedom from reprisal);
- Providing a work environment designed to enhance alertness (for example, appropriate lighting, temperature, and humidity);
- Employing additional supervisory oversight and independent verification when the risk of fatigue is highest (for example, during the night shift, near the end of a shift, working beyond 12 hours);
- Scheduling safety-critical tasks outside of peak times for fatigue (especially between the hours of 2 a.m. and 6 a.m.) when possible; and
- Rotating workers between tasks of varying cognitive and physical workloads when possible.

Results: CHECK

Follow-up/ Evaluation Activities

We found limited recommendations regarding fatigue risk management follow up processes specific to first responders. Although, two sources referenced the follow-up/evaluation stage as an important step to ensuring fatigue controls are efficacious. Further information regarding "check" recommendations can be found within the section Recommendations for "Check" and "Act".

Within the aforementioned fatigue risk assessment tools, certain tools may be applicable as follow-up measures to assess the effectiveness of fatigue risk controls or interventions. For example, the Unit Hour Utilization (UHU) calculation was suggested as a follow-up strategy to inform the effectiveness of controls for first responder fatigue (Fitch & Associates Consulting, 2019). Another tool that may be used by a first responder organization to follow-up with fatigue controls is the Fatigue Cost Calculator (Brigham Health's Sleep Matters Initiative). This is an online tool in which employers can estimate the cost of fatigue on their bottom line. The calculator estimates how much of the burden can be avoided when fatigue risk management programs are implemented in the workplace (Brigham Health, 2019). These tools can be useful for post-implementation of fatigue controls to "check" or assess their effectiveness in reducing the costs of fatigue.

More information regarding the follow-up/evaluation strategies is included in Act.

CISWP

Results: ACT

Corrective Action and Continuous Improvement Policies and Procedures

Actions may be taken towards improving upon fatigue risk control strategies once follow-up has been completed. The National Response Team's Technical Assistance Document, Guidance for Managing Worker Fatigue During Disaster Operations recommended organizations to establish policies and procedures for implementing continuous improvement. This resource stated:

"the organization's policy for conducting evaluations at the end of a response [is described] for incorporation into a "lessons learned" report that will be used to make systemic program changes. Also describe policies and procedures in place for implementing lessons learned. If none exist, consider developing such policies and procedures." (National Response Team, 2009).

Recommendations for "Check" and "Act"

Sources were found supporting both following-up/evaluation activities and establishing organizational corrective action and continuous improvement elements of the overall PDCA process for fatigue risk management for first responders, the Government of Canada's REGDOC-2.2.4: Fitness for Duty: Managing Worker Fatigue states organizations shall conduct periodic assessments to:

1. Determine the effectiveness of the management system in managing the risks associated with worker fatigue and identify opportunities for continuous improvement.

2. Verify that staffing levels are sufficient for enabling adherence to limits on hours of work and recovery periods.

3. Organizations shall carry out trend analyses of problems and the causes related to fatigue or work schedules.

Organizations should use multiple methods to assess the effectiveness of the management system in managing the risks associated with worker fatigue, such as performance indicators, trend analyses, internal and external operating experience, benchmarking, self-assessments, independent assessments, and worker surveys.

An organization's periodic assessment schedule may include a greater frequency of assessments for safety-sensitive positions than for the broad population (Government of Canada, 2014).

General Discussion and Conclusion

From a general web search using a priori determined keywords and from 86 identified national and provincial associations, compensation boards, and government websites, 17 resources were extracted and categorized under the elements of the RACE model or as other organizational elements. The results of this search were re-organized into a broader management system PDCA framework.

Available information pertaining to planning for fatigue risk management for first responders involves work or organizational policies and procedures that should be planned and established as initial steps of the fatigue risk management process. Plan strategies included determining risk factors for fatigue, communication strategies and culture change for fatigue recognition and reporting, fatigue awareness training, and incident reporting strategies. A fatigue cost calculator has been implemented to justify fatigue intervention. Fatigue risk assessment measurements and tools include fatigue/sleep surveys, a fatigue calculator, and a workload assessment tool (Unit Hour Utilization).

Information categorized within Do include work hour restrictions/shift work specifications, fatigue awareness training, work environment/facilities and equipment, organizational recovery time policies and guidelines, sleep hygiene guidelines, a specialized recovery program, workplace wellness programs and guidelines, and physical capacity/pre-emptive testing and training.

The final two elements of the PDCA model, Check and Act, were lacking in specificity. General follow-up recommendations for Check included follow-up activities, in which fatigue assessment strategies could be applied after implementing fatigue controls to check or evaluate their effectiveness in addressing fatigue. General recommendations for Act involved corrective action and continuous improvement.

The data collected reveals limited available, uniform, and complete information regarding the planning, implementation and evaluation of a comprehensive fatigue risk management system currently in practice targeted for first responders. Also, there was very little indication of how fatigue was defined within the resources, including the type of fatigue.

There are several limitations to our study. First, to better facilitate our data extraction, we focused on information pertaining to the risk assessment RACE model and identified pertinent organizational elements; these data were later re-organized into a broader management system PDCA framework that is aligned with Lerman's (2012) fatigue risk management system framework. A targeted approach by directly focusing on elements of the PDCA model may have resulted in a different pool of extracted data; however, given the considerable body of accessed resources, this limitation would have unlikely affected our results. Second, our focus was on Canadian first responders, supplemented with selected sources from the United States and Australia. It is possible that a comprehensive fatigue risk management program exists internationally and in other languages than English, or for other occupations, sectors, or industries, and may serve as a framework for a Canadian first responder fatigue risk management system. Third, our keyword search was limited to the term "fatigue" and excluded possible synonyms, such as "burnout", "physical exhaustion", "compassion fatigue", "mental exhaustion", etc. An expanded keyword search may have resulted in different pool of extracted data but may include information not related to fatigue. Fourth, our search was conducted in English and may have excluded websites and resources where English is not the primary language, including resources from Québec. However, we conducted a targeted search of first responder associations, health and safety associations, and compensation boards of all provinces and territories in Canada.

Lastly, we limited our review to frontline staff, excluding resources solely focused on non-civilian responders (e.g., military police, border police or patrol, correction officers, intelligence officers). Future investigations may draw upon additional information from an expanded search dedicated to fatigue risk management related to specialized operations.

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