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PERSONNEL ENERVATION IN EMERGENCY MEDICAL SERVICES: IDENTIFYING FACTORS CONTRIBUTING TO FATIGUE IN PREHOSPITAL EMERGENCY MEDICAL SERVICES PROVIDERS

A dissertation submitted in partial fulfillment of

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by

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To: Dean William G. Hardin
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This dissertation, written by Robert Anthony Bertulli, and entitled Personnel Enervation in Emergency Medical Services: Identifying Factors Contributing to Fatigue in Prehospital Emergency Medical Services Providers, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

I dedicate this dissertation to the memory of my mother, who always pushed me to be the best I could be, to my sister, who has always been my biggest advocate, regardless of the situation, and to the love of my life, Alesia. This accomplishment would not have been possible without these strong women by my side.

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ABSTRACT OF THE DISSERTATION

PERSONNEL ENERVATION IN EMERGENCY MEDICAL SERVICES: IDENTIFYING FACTORS CONTRIBUTING TO FATIGUE IN PREHOSPITAL EMERGENCY MEDICAL SERVICES PROVIDERS

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Unlike other high-consequence industries, emergency medical services lack practical guidance on reducing provider fatigue. Due to the 24-hour-a-day, seven-day-a-week nature of service requirements on agencies, providers are often placed in situations where they are subjected to making lifesaving decisions while fatigued. Existing research into the causal factors of fatigue in the field of EMS focuses on shift duration and lacks empirical evidence linking other factors to acute fatigue.

This study uses a multistep quasi-experimental quantitative approach to identify causal factors of acute fatigue in emergency medical services personnel outside of shift duration as they relate to the Job Demands-Resources theory. Study findings support the significant role of perceived workload, managerial considerations, and sleep quality in contributing to fatigue in EMS providers.

This research represents a step forward in ensuring that emergency medical services providers can operate safely and efficiently. It will allow for optimal patient care delivery in an environment built on a foundation of safety, accountability, and reduced liability.

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I. INTRODUCTION

Problem Statement

According to the National Emergency Number Association, 240 million calls are placed to 911 annually in the United States (*9-1-1 Statistics - National Emergency Number Association*, n.d.). Call takers answer these calls for assistance and dispatch an ambulance to the location to provide life-saving medical assistance. Medical providers race to the scene to provide interventions that often mean the difference between life and death. The ability of paramedics and emergency medical technicians to make these high-consequence decisions is predicated on good mental acuity and cognitive psychomotor function. As medical providers become fatigued, their mental acuity and psychomotor function become impaired. Fatigue has been associated with crucial mistakes, including adverse patient outcomes, lower job performance, and behaviors that compromise personnel and patient safety (Patterson, Weaver, Frank, et al., 2012).

One such mistake cost a paramedic his life one fateful night. At 3:45 am, an ambulance crew consisting of a 26-year-old female EMT and a 32-year-old male paramedic was transporting a 5-month-old child and the child's mother to a hospital in Indianapolis, Indiana. The paramedic was in the patient compartment, attending to the 5-month-old child and the patient's mother. The EMT, driving the ambulance, fell asleep behind the wheel and failed to stop at a red light. The ambulance struck a vehicle in the intersection, causing the ambulance to roll onto its side. The paramedic in the patient compartment was partially ejected from the back of the ambulance and succumbed to his injuries (Shine, 2018). The driver and passenger of the vehicle that was struck were both injured and were transported to the hospital for treatment (Shine, 2018).

Fatigue is understood and mitigated in many industries through regulations and standard operating procedures. For example, the Federal Aviation Administration, the regulatory body for the civil aviation industry, has issued specific requirements under 14 CFR Part 117 outlining fitness for duty, flight time limitations, duty length limitations, and required rest periods for aircraft pilots (Rudari et al., 2016). Unfortunately, the same cannot be said about the emergency medical field. In the 24-hours-a-day, seven-days-a-week, 365-days-a-year world of emergency medical services, where life and death decisions must be made amid chaos and in a split second, fatigue is placed on a back burner to service requirements. Extant research indicates that over half of EMS personnel report being physically or mentally fatigued while working (Martin-Gill et al., 2018). In addition, many EMS employees get less than six hours of sleep in 24 hours and a half report not recovering sufficiently between shifts to report to duty without being fatigued (Martin-Gill et al., 2018). EMS providers are regularly required to perform at a high level and make critical decisions despite exposure to long work hours. Repeated exposure to traumatic events and adverse work conditions exacerbate providers' vulnerability to mental and physical health problems, including posttraumatic stress disorder and major depressive disorder (Behnke et al., 2020).

EMS administrators face the seemingly insurmountable task of ensuring adequate resources to answer calls for prehospital emergency services in a dynamic environment that requires timely service 24 hours a day while combatting growing fatigue amongst their personnel. An inadequate understanding of the causal factors of fatigue is a limiting factor preventing meaningful regulations and policy change. Failing to understand the facets exacerbating fatigue amongst providers in EMS will lead to continued adverse patient safety events, employee injury, and death.

Research Question

Much of the extant literature regarding fatigue in EMS focuses on shift duration as the primary causal factor without exploring additional potential causal factors that may be contributory. While there is little doubt that shift duration plays a significant role in fatigue, the causal factors of fatigue in emergency medical services are likely more extensive than extant research has provided support for. The Job Demands-Resources Model suggests that strain occurs when an imbalance occurs between the demands of the job and an individual's resources (Bakker & Demerouti, 2007). This study seeks to understand the effects of demands like perceived workload, and resources, like sleep quality, psychological safety, and managerial concern, and how changes to these various factors affect levels of acute fatigue in providers. It is possible that a combination of these factors may ultimately lead to clinical errors, injury, and costly mistakes. Identifying these causal factors and understanding their role in contributing to provider fatigue can help further our understanding of Job Demands-Resource Theory, help administrators build practical solutions to combat fatigue in the workplace, and prevent injury and death to providers and patients.

This research study will address the following research question:

1. What are the factors that contribute to acute fatigue in emergency medical services personnel in the United States?

II. BACKGROUND LITERATURE REVIEW AND THEORY

The term fatigue is ubiquitous in today's culture. We use it colloquially without necessarily understanding or defining the term specifically. As a noun, the Oxford English Dictionary defines fatigue as "lassitude or weariness resulting from either bodily or mental exertion (2023)." Medically, fatigue can be more specifically defined as "a subjective, unpleasant symptom which incorporates total body feelings ranging from tiredness to exhaustion creating an unrelenting overall condition which interferes with an individual's ability to function in their normal capacity (Ream & Richardson, 1996)."

People phenomenologically describe fatigue as a series of feelings. The feeling of sleepiness, drooping eyelids, mental decline, slow reaction time, and unintended dozing off are often associated with being fatigued. Physiologically, it is a state of reduced capability, whether psychological or physical, that may develop as a result of increased workload, extended periods of wakefulness, or a disruption in a person's circadian sleep pattern (Lock et al., 2018). Lock et al. characterize fatigue as acute, cumulative, or circadian in nature (2018). Acute fatigue generally occurs as a result of an identifiable form of exertion, has a rapid onset, and is often relieved by sleep (Piper, 1992). It is this acute fatigue that has become ubiquitous within emergency medical services.

Fatigue has been linked to an increased impairment of cognitive functions, reduced decision-making capacity, difficulty with emotional regulation, and poor task performance (Dawson et al., 2021). As impairment occurs, the human body uses compensatory behaviors to reduce the effects of fatigue and, thus, the possibility of adverse outcomes (Dawson et al., 2021). Fatigued EMS personnel are at 1.9 greater odds of becoming injured, 2.2 greater odds of committing a medical error, and 3.6 greater odds of engaging in behavior that compromises safety (Patterson, Weaver, Frank, et al., 2012). Adverse patient outcomes, vehicular accidents, and provider injuries become more prevalent as fatigue increases (Patterson & Martin-Gill, 2018).

Considering the danger of fatigue-related events in emergency medical services, it is disturbing that the prevalence of fatigue within the industry continues to rise (Patterson & Martin-Gill, 2018). A large majority of EMS providers admit to being fatigued while on the job (Patterson et al., 2017). Extant literature shows that over half of EMS personnel report mental and physical fatigue during the workday and complain of excessive daytime sleepiness (Patterson et al., 2010; Pirrallo et al., 2012).

Previous studies have focused most of their research on the effects of sleep quality and shift length in prehospital providers (Patterson et al., 2010). Current recommendations from industry experts focus on reducing shift length, allowing for naps on duty, allowing providers access to caffeine, and increasing education on fatigue recognition (Patterson, Higgins, Weiss, et al., 2018). These recommendations are of low quality and are limited in their potential to reduce fatigue (Martin-Gill et al., 2018). These current industry-accepted recommendations focus on shift length as the primary causal factor of fatigue. With the limited exploration into other potential factors that may play an equal or more significant role in fatigue in the prehospital environment, further research is required.

Although studies have found preliminary evidence that poor sleep quality and fatigue are common in EMS, the research has been limited and has not focused on other factors that may contribute to a more significant portion of the overall model (Patterson, Weaver, Frank, et al., 2012). Researchers in the field recognize that limited empirical data exists to assess fatigue in emergency medical services employees and that more research is necessary to understand better the factors involved in understanding fatigue in the field (Patterson, Weaver, Hostler, et al., 2012).

In their article, *Fatigue Risk Management in High-Risk Environments: A Call To Action,* Hersman and Whitcomb detail that 24-hour operations, like emergency medical services (EMS), disrupt the normal sleep patterns of EMS providers (Hersman & Whitcomb, 2018). These sleep pattern disruptions increase the prevalence of fatigue-related events. The National Transportation Safety Board has identified fatigue as a contributory factor in several accidents in high-risk industries. These findings have led to more than 200 recommendations from the NTSB on mitigating fatigue in high-risk sectors like EMS (Hersman & Whitcomb, 2018).

In 2015, the National Highway Traffic Safety Administration, in response to a recommendation from the National EMS Advisory Council, awarded the National Association of State EMS Officials and a group of researchers led by the University of Pittsburgh's School of Medicine, Department of Emergency Medicine, a contract to develop evidence-based guidelines for EMS specific fatigue risk management (Patterson & Martin-Gill, 2018). Phase one of this research led to five fatigue risk management recommendations for first responders. These recommendations included using fatigue survey instruments for monitoring fatigue, limiting shift length to less than 24 hours, providing caffeine during shifts, allowing naps while on duty, and providing EMS providers with education on managing fatigue (Patterson & Martin-Gill, 2018).

Following the issuance of recommendations from the evidence-based guidelines for fatigue risk management, a series of theoretical performance indicators or metric-style recommendations were issued to measure the effectiveness of implementing the five fatigue risk management strategies (Martin-Gill et al., 2018). The first performance indicator recommended that EMS administrators use fatigue survey measures to monitor fatigue in EMS providers (Martin-Gill et al., 2018). The panelists concluded that the goal should be to assess EMS personnel every three months with a reliable and valid survey method (Martin-Gill et al., 2018). The second performance measure set a goal of 100% shifts being less than 24 hours in duration (Martin-Gill et al., 2018). The third performance measure measured the percentage of shifts where providers have access to caffeine while on duty (Martin-Gill et al., 2018). The goal of this measure was 100% access to caffeine every shift. For the recommendation that EMS personnel have the opportunity to nap while on duty, the fourth performance measure should measure the percentage of shifts EMS providers had access to and permission to nap while on duty (Martin-Gill et al., 2018). The goal of this measure is access to naps on duty 100% of a provider's shifts. Finally, the fifth performance measure focused on the percentage of employees who received fatigue mitigation and recognition training in new hire orientation and continuing education bi-annually (Martin-Gill et al., 2018). The goal for this measure is 100% of new hire personnel.

Although these recommendations were made and performance indicators developed, no reliable survey methods were issued in conjunction with them. Additionally, no steps were suggested to implement these industry suggestions or the performance indicators that should accompany them. Without a roadmap for implementation or some basic guidance, administrators were left without a clear-cut course of action. As is often the case with theoretical recommendations, the guidance lacked the steps necessary for a successful implementation.

Emergency medical services (EMS) providers operate within a unique environment that requires 24-hour service to those they serve. Many of the current strategies to reduce workload in various industries focus on minimizing work at night and reducing the duration of work. These strategies effectively reduce fatigue in many industries but are often impractical and unattainable in the 24/7/365 world of EMS.

Emergency medical services providers' shift work challenges optimal sleep health by forcing the body to be awake when we should be sleeping and attempting to sleep when the body is preparing for wakefulness (Buysse, 2018). As a result, providers are at a greater risk for obesity and metabolic dysfunction (Buysse, 2018). Individuals who sleep less than six hours a night are at an increased risk for mortality, depression, and cardiovascular disease. Regular sleep patterns are engrained into human biology down to the molecular level. Sleep is regulated by a homeostatic sleep drive, which promotes wakefulness during the day and sleepiness during the nighttime hours (Buysse, 2018). The hypothalamus regulates this circadian rhythm in the brain. Circadian rhythms are critical to cellular and systematic metabolism (Buysse, 2018).

The shifts that emergency medical services personnel work make them particularly susceptible to the transitional state between sleep and wakefulness. This period, referred to as sleep inertia, lasts from 15 to 120 minutes and is marked by decreased cognitive performance (Dawson et al., 2021). Since EMS personnel regularly work shifts that require them to complete dangerous tasks and make critical decisions immediately after waking up, periods of sleep inertia are associated with significantly increased risk.

Hersman and Whitcomb issue a call for action to employers to learn about fatigue and how it can be mitigated effectively (2018). Instituting a science-based fatigue risk management system can help identify the causes of fatigue and thus assist with instituting effective countermeasures. Unfortunately, current EMS officials lack compelling research that sheds light on a broader variety of causal factors of fatigue in EMS.

Fatigue risk management focuses more on ensuring an employee is safe than eradicating fatigue. High levels of fatigue do not always correlate to high levels of risk. For example, an employee falling asleep at a desk while fatigued does not pose the same risk as someone falling asleep while driving a truck down the highway. Similarly, someone who may not be considered highly fatigued may miss a subtle change that may have serious consequences, such as those seen at Three Mile Island (Dawson et al., 2021). While it may be easy to assume that longer shifts equate to increased fatigue, there is limited empirical data assessing EMS personnel fatigue (Patterson, Weaver, Hostler, et al., 2012).

Implementing a successful fatigue risk management program is not simple. Every decision to reduce fatigue in one area has ramifications in another (Patterson, Higgins, Dongen, et al., 2018). Moreover, existing recommendations in the field have been based on evidence that, although substantial, is of low quality (Patterson, Higgins, Dongen, et al., 2018).

Patterson et al. cautioned policymakers on making workforce deployment decisions in the absence of further research into the causes of fatigue (Patterson, Weaver, Hostler, et al., 2012). Existing gaps in research into fatigue in EMS support the need for further research into the causes of fatigue in emergency medical services (Patterson, Weaver, Hostler, et al., 2012). More exhaustive research in the field will help gain a more robust understanding of the underlying causal factors contributing to EMS fatigue. This research will help enhance the understanding of fatigue in emergency medical services and may help drive fatigue risk management programs.

III. RESEARCH DESIGN

Conceptual Framework

A conceptual model was developed to illustrate the hypothesized variables in this study. The model in Figure 1 illustrates the hypothesized direct effects of four constructs: Psychological Safety, Perceived Workload, Sleep Quality, and Managerial Consideration, and their effect on the dependent variable, Acute Fatigue in EMS Personnel. The model accounts for five distinct hypotheses, elaborated below.

Figure 1 Conceptual Research Model

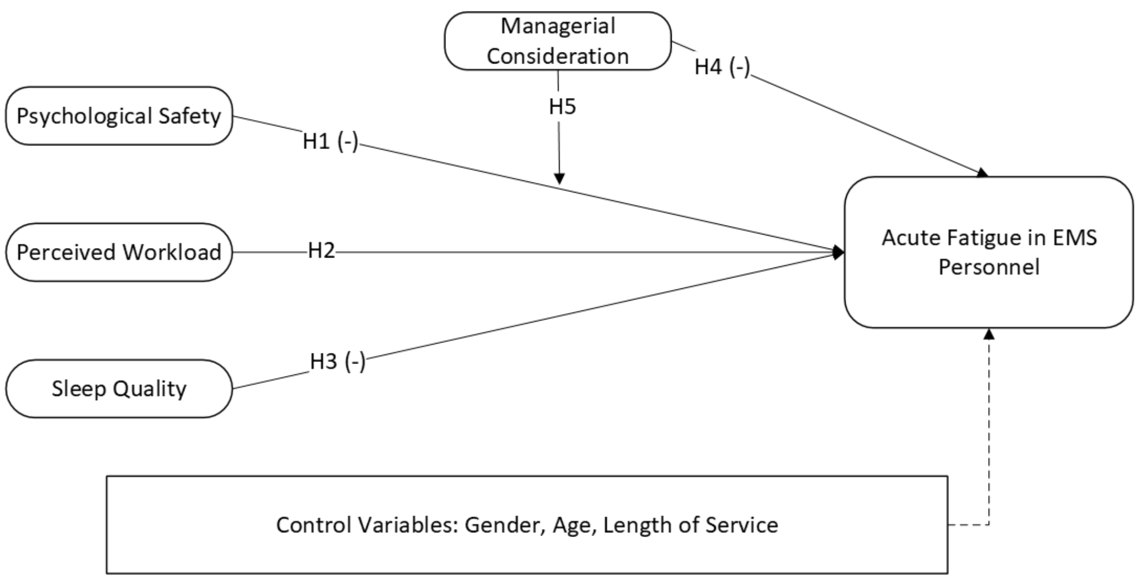


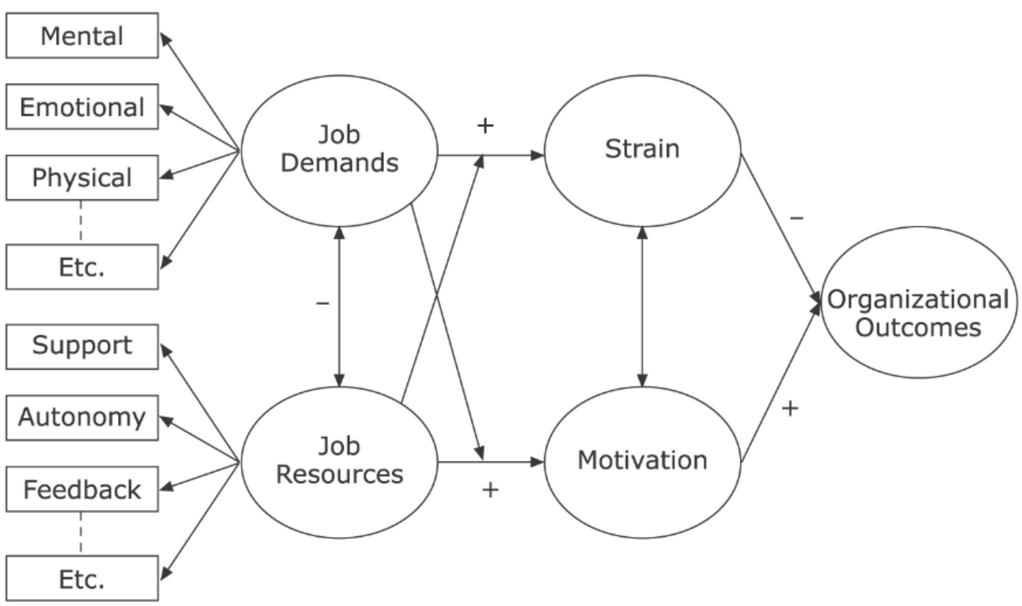
Figure 2 Latent Construct Definitions

Latent Construct	Variable Type	Definition	Reference
Acute Fatigue (AF)	Dependent	a new onset subjective, unpleasant symptom which incorporates total body feelings ranging from tiredness to exhaustion creating an unrelenting overall condition which interferes with an individual's ability to function in their normal capacity	(Winwood et al., 2005)
Psychological Safety (PS)	Independent	The degree to which a member of an organization fees sufficiently safe that the interpersonal and career threat is low enough that they can ask for help, admit errors, and discuss problems that arise to members of the organization	(A. Edmondson, 1999)
Perceived Workload (PW)	Independent	The cost incurred by a human operator to achieve a particular level of performance encompassing the combination of physical, mental, and temporal demands placed on that individual.	(Hart & Staveland, 1988)
On-Duty Sleep Quality (SQ)	Independent	A measurement of regularity, overall sleep satisfaction, alertness during waking hours, sleep time, sleep efficiency relative to the duration of sleep, and the duration spent sleeping	(Parrott & Hindmarch, 1980)
Managerial Consideration (MC)	Independent and Moderating	The level of leaders' concern over the comfort, well-being, status, and contributions of their subordinates	

Theoretical Development and Hypotheses

Job Demands-Resources theory proposes that every field has a series of factors contributing to job stress. These individual factors fall into two categories: demands or resources (Bakker & Demerouti, 2007). Job demands are the individual physical, organizational, psychological, and social aspects of the job that require specific skills and sustained effort (Bakker & Demerouti, 2007). These demands may be positive or negative and result in some form of physiological or psychological cost (Bakker & Demerouti, 2007). Resources, on the other hand, are those aspects of the job that assist with achieving work goals, reduce demands and the associated costs of those demands, and stimulate employee growth and development (Bakker & Demerouti, 2007). These two processes contribute to either the development of job strain or motivation. Job strain manifests itself in a multitude of ways, including exhaustion, fatigue, and burnout, leading to adverse organizational outcomes. Motivation increases job competence, social support, and autonomy, ultimately leading to positive organizational outcomes. Each hypothesized independent variable is categorized as either a demand or a resource.

Figure 3 Job Demands - Resources Model



Psychological Safety

Anytime an employee chooses to speak up about a perceived issue within their organization, they open themselves up to risk by opposing the standard of operations within an organization (Detert & Burris, 2007). As such, the risk of speaking out when an issue exists may outweigh the perceived benefits of saying something (Detert & Burris, 2007). There is growing evidence that employees will not speak out for fear of retribution and retaliation.

Psychological safety exists when a member of an organization feels sufficiently safe that the interpersonal and career threat is low enough that they can ask for help, admit errors, and discuss problems that arise with other members of the organization (A. Edmondson, 1999). The higher the level of psychological safety, the safer the member feels to speak out about issues that may arise, including fatigue-related events.

Psychological safety has been shown to be a mechanism that affects performance and behavioral outcomes (A. Edmondson, 1999). Individuals who feel a high level of psychological safety within their organization are more likely to ask questions and seek help when faced with a situation where they find themselves fatigued and unable to complete a job assignment safely (A. Edmondson, 1999). Individuals who feel confident to bring up fatigue-related concerns without fear of punishment are likely to raise safety concerns and be more risk-averse than others who fear retribution. Additionally, studies have shown that emotional exhaustion is less likely to occur when individuals have the resources to cope with their work's daily demands properly (Zhou & Chen, 2021).

Hypothesis 1 (H1): As psychological safety of the personnel increases, the effect on acute personnel fatigue will decrease.

Perceived Workload

The Job Demands-Resources theory describes workload as a demand that has the potential to cause strain if not balanced with the necessary resources (Bakker & Demerouti, 2007). Workload is generally understood as the amount of work performed within a particular period. While this understanding is sufficient for describing a piece of machinery or equipment, it fails to account for various physical and psychological factors that affect how humans perceive workload. If, instead, workload is dissected more granularly, it can be better defined and measured. From a healthcare provider standpoint, workload increases as a result of increased patient interactions, increased patient acuity, patient age, and length of patient care time (Groenewegen & Hutten, 1991). Prior studies support the claim that call volume significantly contributes to burnout in the EMS field (Crowe et al., 2018). Additionally, workload has a psychological component. The psychological component encompasses the provider's mental workload, including how well they feel they can handle the workload and deal with the pressure of a given situation (Groenewegen & Hutten, 1991). Hart and Staveland described this as a "hypothetical construct that represents the cost incurred by a human operator to achieve a particular level of performance (1988)." They measure workload as a combination of mental, physical, and temporal demands placed on an individual (Hart & Staveland, 1988).

As perceived workload increases disproportionately to the available resources, strain increases, causing physiological and physical fatigue (Crowe et al., 2018). This may be particularly dangerous in emergency medical services, as previous studies in other areas of medicine have shown that workload affects the quality of care provided to patients (Maghsoud et al., 2022).

Hypothesis 2 (H2): As the personnel's perceived workload increases, the effect on acute personnel fatigue will increase.

On-Duty Sleep Quality

Sleep health encompasses aspects of regularity, overall sleep satisfaction, alertness during waking hours, sleep time, sleep efficiency relative to the duration of sleep, and the duration spent sleeping (Buysse, 2018). Hersman and Whitcom found that 24-hour operations disrupt providers' sleep patterns and can increase the prevalence of fatigue-related events (2018). Prior studies have also shown that poor sleep quality and duration affect emergency medical services providers' fatigue levels (Patterson et al., 2010).

EMS providers who work 24-hour or longer shifts regularly have disruptions in their on-duty sleep. When EMS providers are able to sleep, frequent disruptions may lead to acute sleep deprivation. Although studies show a benefit to napping while on duty, these effects may be substantially reduced if acute sleep deprivation occurs (Dragon, 2020). Acute sleep deprivation has been linked to increased anxiety, obesity, poor metabolic health, as well as an increased risk of strokes and myocardial infarctions (Lock et al., 2018). More concerningly, there is a large body of evidence that provides connections between fatigue, cancer, and all-cause mortality (Lock et al., 2018). The potential exists for a provider's sleep quality on duty to directly affect acute fatigue.

Hypothesis 3 (H3): As the provider's on-duty sleep quality increases, the effect on acute personnel fatigue will decrease.

Managerial Consideration

Managerial consideration is the level of leaders' concern over their subordinates' comfort, well-being, status, and contributions (Stogdill et al., 1962). Administrators prioritizing service requirements over provider well-being and comfort may create high job demands that lead to burnout and decreased job performance (Schaufeli et al., 2006; Stogdill et al., 1962). Conversely, administrators concerned with providers and their well-being are more likely to create an environment that reduces job demands and creates a more supportive work environment that can help alleviate feelings of exhaustion and fatigue (Barnes et al., 2015). Thus, managerial consideration can be either a resource or a job demand, based on the level of managerial consideration.

When managerial consideration is low, the resulting administrative actions often increase job demands, causing an imbalance between job demands and resources, leading to strain, exhaustion, and fatigue (Bakker & Demerouti, 2007). Administrators with a high level of managerial consideration become a resource, lowering job demands and increasing provider support (Bakker & Demerouti, 2007). A study by Xanthopoulou on healthcare workers showed that job resources were positively related to work engagement and negatively related to emotional exhaustion (2007).

Hypothesis 4 (H4): As managerial consideration increases, the effect on acute personnel fatigue will decrease.

Hypothesis 5 (H5): Managerial consideration will moderate the effect of psychological safety on acute personnel fatigue such that as managerial consideration increases, the effect of the relationship will become stronger.

Control Variables

To better understand the relationships between the latent variables hypothesized above and conduct rigorous hypothesis testing on the focal variables in the most conservative way possible, it was necessary to isolate relevant variables that may affect the hypothesized relationships while not being directly relevant to the study (Bernerth & Aguinis, 2016). Considering that empirical evidence exists correlating gender, age, and length of service to the latent variables, and the understanding that those variables are capable of being measured accurately within this study, the variables were included in the study as control variables (Bernerth & Aguinis, 2016).

Table 1 Hypotheses

Hypothesis	
H1	As the psychological safety of the personnel increases, the effect on acute personnel fatigue will decrease.
H2	As the personnel's perceived workload increases, the effect on acute personnel fatigue will increase.
H3	As the provider's on-duty sleep quality increases, the effect on acute personnel fatigue will decrease.
H4	As managerial consideration increases, the effect on acute personnel fatigue will decrease.

H5	Managerial consideration will moderate the effect of psychological safety on acute personnel fatigue such that as managerial consideration increases, the effect of the relationship will become stronger.

IV. RESEARCH METHODOLOGY

Introduction

This study employed a three-part technique to evaluate the proposed model and test hypotheses. The first part of the study was an informed pilot used to validate the reliability of the constructs, the data collection process, and the survey instrument. The second part of the study consisted of a primary pilot. The primary pilot was used to validate the data collection methodology further. The data collected during the primary pilot was used to conduct exploratory factor analysis and reliability testing on the survey instrument. The last part of the study was the main study. The main study collected data to test the hypotheses outlined in Section III of this paper. The findings of the main study are reported extensively in Section V.

Population of Interest

The population of interest for this study was nationally or state-certified emergency medical responders, emergency medical technicians, advanced emergency medical technicians, paramedics, and nurses over the age of 18 working in a government ambulance service (EMS only), fire or police-linked service (Fire rescue, etc.), private ambulance service, hospital-based ambulance service, or volunteer ambulance service.

Unit of Analysis

This study sought to establish a causal linkage between various factors and their contribution to acute fatigue in emergency medical services providers working in the United States. To accomplish this, the survey instrument was administered to the sample population after the end of the shift and crafted to reference the events of the participant's last shift. The unit of analysis for this study was the individual emergency medical services provider.

Sample Population

The study's sample population was comprised of a random sample of 221 nationally or state-certified emergency medical responders, emergency medical technicians, advanced emergency medical technicians, paramedics, and nurses working in a government ambulance service, fire or police-linked service, private ambulance service, hospital-based ambulance service, or volunteer ambulance service. All participants were eighteen years of age or older.

Data Collection

Qualified study participants were recruited at random through advertisements on the LinkedIn and Facebook social media platforms. Participants in the study answered a quantitative internet-based survey within the Qualtrics platform at the end of their duty shift. The survey data for each participant was used to measure the latent variables accurately.

Research Instrument

The primary research instrument for this study was a quantitative internet-based survey developed and delivered within the Qualtrics platform. The survey was designed to measure latent variables by adopting previously validated survey scales adapted to this study.

Latent Variable Measurement Scales

Acute Fatigue (AF)

The dependent variable in this study, acute fatigue, was measured by adapting the Occupational Fatigue Exhaustion Recovery scale developed by Winwood et al. This scale was validated in three different study populations and discriminately differentiated between chronic work-related fatigue states, acute end-of-shift states, and effective work recovery between shifts (Winwood et al., 2005). The scale was chosen due to its robust psychometric characteristics explicitly developed to measure work-related fatigue (Winwood et al., 2005).

Sleep Quality (SQ)

The independent variable sleep quality was evaluated by adapting the Leeds Sleep Evaluation Questionnaire from the University of Leeds (Parrott & Hindmarch, 1980). This independently validated scale was chosen due to its success measuring subjectively perceived differences in sleep during a host of pharmacological studies. The scale is useful in documenting subjectively perceived changes in sleep and waking behavior with reasonable reliability and validity (Parrott & Hindmarch, 1980).

Managerial Consideration (MC)

The independent variable managerial consideration was measured by adapting the Leader Behavior Description Questionnaire, developed by staff at The Ohio State University (Halpin, 1957a). This scale was chosen due to its validated ability to measure how individuals describe the behavior of designated leaders in formal organizations

(Halpin, 1957a). Researchers have successfully used the LBDQ in various industries with similar success.

Perceived Workload (PW)

The independent variable perceived workload was measured using the National Aeronautics and Space Administration Task Load Index (Hart & Staveland, 1988). This scale was chosen for its ability to measure various aspects of subjective workload, including mental demand, physical demand, temporal demand, effort, performance, and frustration level (Hart & Staveland, 1988).

Psychological Safety (PS)

The independent variable, psychological safety, was measured by adapting Edmondson's Psychological Safety Scale (Edmondson, 1999). As the researcher who codified the theory of psychological safety, the scale is the primary quantitative measure for measuring psychological safety in various settings (A. C. Edmondson, 2003).

Pilot Studies

Informed Pilot

Before engaging in the primary pilot stage of this study, an informed pilot was conducted to validate the technical reliability of the survey instrument and ensure face, content, and construct validity. The informed pilot participants were provided with the survey instrument on the Qualtrics Experience Management platform, a detailed description of the research, the theoretical research model, a description of the primary pilot, and a list of items to consider when evaluating the survey instrument (see Appendix I).

The informed pilot ran between August 9, 2023, and August 11, 2023. Participants included three industry subject matter experts and three doctoral research candidates. The informed pilot participants validated the technical functionality of the survey instrument and contributed suggestions about the questions contained within. Participants pointed out potential data collection issues with the way the survey rendered in specific internet browsers, provided recommendations regarding the wording of certain questions, and gave encouraging words regarding the overall design and structure of the instrument.

Based on the feedback from the informed pilot participants, several adjustments were made to the survey instrument. The formatting of the survey was adjusted to ensure proper rendering in mobile internet browsers, and questions were reworded to improve clarity and remove double-barreled questions.

Primary Pilot

After adjusting the survey instrument based on the feedback from the informed pilot, a primary pilot was undertaken between October 1, 2023, and October 8, 2023, by engaging prehospital emergency medical providers on LinkedIn and Facebook, with a target of 75 respondents. Respondents participated in the pilot voluntarily and were not compensated for their time. A total of 86 respondents followed the link and engaged in the survey. Of the 86 total respondents, 19 failed to complete the survey to at least 85%

were excluded from the data, resulting in 67 complete surveys to conduct further analysis on.

The pilot data was analyzed using IBM's SPSS Statistics software v28.0.1. A principal axis factor analysis was conducted on 31 items with orthogonal (Varimax) rotation. The Kaiser-Meyer-Olkin measure verified that the sample was adequate for analysis, with a KMO measure of .765. The diagonals of the anti-image correlation matrix showed that all but two variables were above the minimum of 0.5. Bartlett's Test of Sphericity was significant ($\chi2(465) = 611.224$, $p < .001$). Based on the KMO measure of the individual variables, two questions, SQ.5 and PS.3, were excluded from the factor analysis. Factor analysis was deemed suitable for the remaining 29 items.

An initial analysis was run to obtain eigenvalues for each factor in the data. As expected, the five factors produced Eigenvalues greater than 1, accounting for a cumulative explanation of 73.14% of the variance. The items clustered on the same factor verify that factor one represents acute fatigue, factor two represents sleep quality, factor three represents managerial consideration, factor four is perceived workload, and factor five is psychological safety.

Each scale was examined for internal consistency using Cronbach's alpha (α). The αs were .926 for Acute Fatigue (5 items), .867 for Sleep Quality (5 items), .885 for Managerial Consideration (5 items), .834 for Perceived Workload (3 items), and .691 for Psychological Safety (3 items). Eliminating more items would not have resulted in substantial increases to the α of any of the scales.

The primary pilot results verify that the survey instrument had good reliability and construct validity and is valid for measuring the study's five main constructs: Acute Fatigue (AF), Sleep Quality (SQ), Managerial Consideration (MC), Perceived Workload (PW), and Psychological Safety (PS). Table 2 shows the descriptive statistics of the pilot data, including the item code, mean, standard deviation, and αs for the primary pilot measures.

Table 2 Pilot Data Descriptive Statistics (n=171)

Construct Name and Reference	Item Code	Mean	Std. Deviation	α
Acute Fatigue (AF)	AF.1	4.79	1.684	.926
(Winwood et al., 2005)	AF.3	5.15	1.490	
	AF.4	5.27	1.728	
	AF.5	4.28	1.953	
	AF.6	4.69	1.844	
	AF.2	*N/A*	*N/A*	
Sleep Quality (SQ)	SQ.3	2.64	2.404	.867
(Parrott & Hindmarch, 1980)	SQ.4	3.14	2.428	
	SQ.6	2.31	2.253	
	SQ.7	3.19	2.867	
	SQ.8	3.53	2.420	
	SQ.1	*N/A*	*N/A*	
	SQ.2	*N/A*	*N/A*	
	SQ.9	*N/A*	*N/A*	
	SQ.10	*N/A*	*N/A*	
Managerial Consideration (MC)	MC.1	4.60	1.268	.885
(Halpin, 1957b; Stogdill et al., 1962)	MC.2	4.07	1.385	
	MC.3	4.73	1.431	
	MC.4	3.75	1.418	
	MC.5	3.18	1.476	
Perceived Workload	PW.1	4.49	1.727	.834
(Hart & Staveland, 1988)	PW.2	4.25	1.551	

	PW.3	4.46	1.673	
	PW.4	*N/A*	*N/A*	
	PW.5	*N/A*	*N/A*	
	PW.6	*N/A*	*N/A*	
Psychological Safety (A. Edmondson, 1999)	PS.1	3.72	1.584	.691
	PS.4	4.16	1.629	
	PS.5	4.36	1.593	
	PS.2	*N/A*	*N/A*	
	PS.3	*N/A*	*N/A*	

Note: Italicized items were not factored into the calculation of the α of the scales due to low factor loading or cross-loadings.

V. DATA ANALYSIS AND RESULTS

Demographic Statistics

The main study was conducted in a manner similar to that of the primary pilot. Survey respondents were recruited from the social media platforms LinkedIn and Facebook and directed to the Qualtrics platform survey instrument. As with the primary pilot, respondents were not compensated for their participation in the study. All measures present in the primary pilot were retained and used for the main study. The main study ran from November 7, 2023, through December 20, 2023, and collected 221 respondents. Of the 221 respondents, one failed to consent and left without completing the survey. Of the remaining 220 respondents, 48 failed to complete the survey to at least 85% and were excluded from the data. One individual who took the survey failed to meet the necessary inclusion criteria and was removed. The result was 171 complete surveys to conduct further analysis on (n=171). None of the remaining elements exhibited more than 5% missing values; thus, no data modification was necessary (Schafer, 1999).

SPSS was used to conduct frequencies and analysis of the demographic data collected. 124 of the 171 respondents (72.5%) identified as male and 47 (27.5%) identified as female. Although the survey respondents are predominantly male, this finding is consistent with the national average for the profession, with 68.4% of paramedics identifying as male and 31.6% identifying as female (*Paramedic Demographics and Statistics [2024]*, 2021). Most respondents were between the ages of 35 and 44, 36.3% (n=62) of the study sample. Fifteen respondents were between the ages of 18 and 24 (8.8%), 52 were between the ages of 25 and 34 (30.4%), 22 respondents were between the ages of 45 and 54 (12.9%), 19 respondents were between the ages of 55 and 64 (11.1%), and one participant was 65 years of age or older (0.6%). Most respondents worked for either a government ambulance service (n=62, 36.3%) or a private ambulance service (n=63, 36.8%), followed by fire or police-based services (n=22, 12.9%) and hospital-based services, respectively (n=21, 12.3%). Respondents were overwhelmingly paramedics, comprising 66.7% of the sample (114), followed by emergency medical technicians, who accounted for 29.8% (51). 82.5% (141) of the providers work on an advanced life support ambulance. Provider experience varied between 0 and over 20 years of experience, with most respondents either having 0-5 years or greater than 20 years of experience (24.6% and 24.6% respectively). Most survey respondents had an associate degree or less education (113, 66.1%). Only 39 respondents had a bachelor's degree (22.8%), and 19 had a master's degree or better (11.1%). Table 3 highlights the demographic statistics.

Table 3 Main Study Sample Characteristics

		Count	Column N %
Age	18-24	15	8.8%
	25-34	52	30.4%
	35-44	62	36.3%
	45-54	22	12.9%
	55-64	19	11.1%
	65+	1	0.6%
Gender	Male	124	72.5%
	Female	47	27.5%
Employment Type	Government ambulance service (EMS only)	62	36.3%
	Fire or police-linked service (Fire rescue, etc.)	22	12.9%
	Private ambulance service	63	36.8%

	Hospital-based ambulance service	21	12.3%
	Volunteer ambulance service	1	0.6%
	Other service not listed	2	1.2%
Level of Professional Certification	Emergency Medical Responder	1	0.6%
	Emergency Medical Technician (EMT-B, NREMT)	51	29.8%
	Advanced Emergency Medical Technician (NRAEMT)	1	0.6%
	Paramedic (EMT-P, NRP)	114	66.7%
	Nurse (LPN, RN)	4	2.3%
Response Level	Advanced Life Support	141	82.5%
	Basic Life Support	18	10.5%
	Critical Care	12	7%
Years of Experience	0-5 Years	42	24.6%
	6-10 Years	27	15.8%
	11-15 Years	34	19.9%
	16-20 Years	26	15.2%
	Greater than 20 Years	42	24.6%
Education Level	High school diploma or GED	10	5.8%
	Some college, but no degree	44	25.7%
	Associate's or technical degree	59	34.5%
	Bachelor's degree	39	22.8%
	Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS, etc.)	19	11.1%

Partial least squares structural equation modeling (SEM) was used to analyze the main study model. Partial least squares structural equation modeling was chosen for its ability to perform confirmatory factor analysis, analyze direct and moderating effects, and its predictive powers in the presence of a limited sample size due to the restrictive nature of the sample population being studied (Martens & Haase, 2006; Rigdon, 2016). Additionally, PLS-SEM is more likely to identify significant relationships present in the population than other analysis methods, reducing the possibility of a type II error (Hair et al., 2022).

To analyze the study data, a reflective measurement model was created in SmartPLS v4.0.9.9, mirroring the conceptual research model. Confirmatory factor analysis was performed by examining the model's indicator loadings and cross-loadings. Indicator loadings were examined to ensure acceptable indicator reliability above the threshold value of 0.708, indicating that the construct explains more than 50% of the indicator's variance (Hair et al., 2019). All items with indicator loading below 0.708 were removed (Hair et al., 2019). In total, six items were retained for acute fatigue, three items were retained for managerial consideration, three items were retained for psychological safety, four items for perceived workload, and four items were retained for sleep quality, as shown in Table 4.

Table 4 Discriminant Validity Cross Loadings

	Acute Fatigue	Managerial Consideration	Psychological Safety	Perceived Workload	Sleep Quality
AF.1	**0.859**	-0.37	-0.225	0.324	-0.29
AF.2	**0.888**	-0.376	-0.258	0.509	-0.414
AF.3	**0.92**	-0.344	-0.248	0.376	-0.332
AF.4	**0.866**	-0.26	-0.206	0.364	-0.36
AF.5	**0.858**	-0.325	-0.235	0.397	-0.261
AF.6	**0.9**	-0.341	-0.225	0.442	-0.253
MC.2	-0.344	**0.881**	0.469	-0.316	0.206
MC.3	-0.167	**0.775**	0.404	-0.389	0.143
MC.5	-0.39	**0.891**	0.482	-0.317	0.28
PS.1	-0.272	0.412	**0.888**	-0.332	0.353
PS.2	-0.205	0.536	**0.783**	-0.296	0.225
PS.4	-0.131	0.355	**0.765**	-0.206	0.276
PW.1	0.204	-0.174	-0.105	**0.816**	-0.058
PW.2	0.241	-0.281	-0.182	**0.805**	-0.083
PW.3	0.378	-0.27	-0.211	**0.841**	-0.152
PW.6	0.499	-0.403	-0.466	**0.777**	-0.233
SQ.3	-0.33	0.088	0.123	-0.111	**0.84**
SQ.4	-0.25	0.109	0.249	-0.081	**0.822**
SQ.6	-0.307	0.367	0.447	-0.151	**0.845**
SQ.8	-0.285	0.276	0.339	-0.279	**0.72**

The outer model's psychometric properties were assessed for internal consistency reliability using rho_a, rho_c, and Chronbach's α (Jöreskog, 1971). A review of the model's rho_c values found that all values were above the threshold of 0.80 and were "satisfactory to good," according to Jöreskog (1971). Similarly, the model's Chronbach's αs were all greater than 0.8, with managerial concern being the lowest at 0.820 and Acute fatigue being the highest at 0.943, indicating that the constructs are robust and reliable (Taber, 2017). As composite reliability and Chronbach's α may be considered extreme values of reliability, the model's rho_a was also evaluated (Dijkstra & Henseler, 2015). The model's rho_a values were all found to be at an acceptable level, with the lowest being psychological safety at 0.821 and the highest being acute fatigue at 0.950.

Convergent validity was assessed by examining the model's average variance extracted for all items on each construct (Hair et al., 2019). The average variance extracted indicates the amount of variance captured by a particular construct relative to the amount of variance due to measurement error (Fornell & Larcker, 1981). An AVE less than 0.5 would indicate that the variance due to measurement error is greater than the variance captured by the construct, calling into question the validity of the construct (Fornell & Larcker, 1981). The AVE for all constructs was greater than the threshold of 0.5 and, thus, was deemed acceptable (Hair et al., 2019). The composite and convergent validity values are highlighted in Table 5.

Table 5 Construct Reliability and Validity

	Cronbach's α	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
Acute Fatigue	0.943	0.95	0.955	0.778
Managerial Consideration	0.82	0.888	0.887	0.724
Perceived Workload	0.839	0.89	0.884	0.656
Psychological Safety	0.754	0.821	0.854	0.662
Sleep Quality	0.822	0.829	0.883	0.654

The last step in assessing the measurement model was determining discriminant validity by verifying that each construct is empirically distinct from other constructs in the model (Hair et al., 2019). The shared variance, in the form of the construct's squared inter-construct correlation, was compared to the construct's AVEs to ensure that none of the shared variances were larger than their AVEs (Fornell & Larcker, 1981). As shown in

Table 6, all of the construct's AVEs are larger than the shared variance of the model's constructs. Additionally, the heterotrait-monotrait ratio of the correlations, the mean value of the item correlations across constructs relative to the mean of the average correlations for the items measuring the same construct, were examined to ensure that none of the values exceeded 0.85 (Henseler et al., 2015). All values were less than the conservative threshold of 0.85 and deemed acceptable (Henseler et al., 2015). The HTMT ratios for the constructs are displayed in Table 7.

Table 6 Fornell-Larker Criterion

	Acute Fatigue	Managerial Consideration	Perceived Workload	Psychological Safety	Sleep Quality
Acute Fatigue	0.882				
Managerial Consideration	-0.382	0.851			
Perceived Workload	0.461	-0.381	0.81		
Psychological Safety	-0.265	0.534	-0.354	0.814	
Sleep Quality	-0.366	0.261	-0.193	0.355	0.808

Table 7 Heterotrait-Monotrait Ratio (HTMT)

	Acute Fatigue	**Managerial Consideration**	**Perceived Workload**	**Psychologica l Safety**	**Sleep Quality**
Acute Fatigue					
Managerial Consideration	0.396				
Perceived Workload	0.446	0.438			
Psychological Safety	0.292	0.663	0.35		
Sleep Quality	0.406	0.296	0.213	0.447	
Managerial Consideration x Psychological Safety	0.084	0.164	0.206	0.129	0.085

Structural Model and Hypotheses Testing

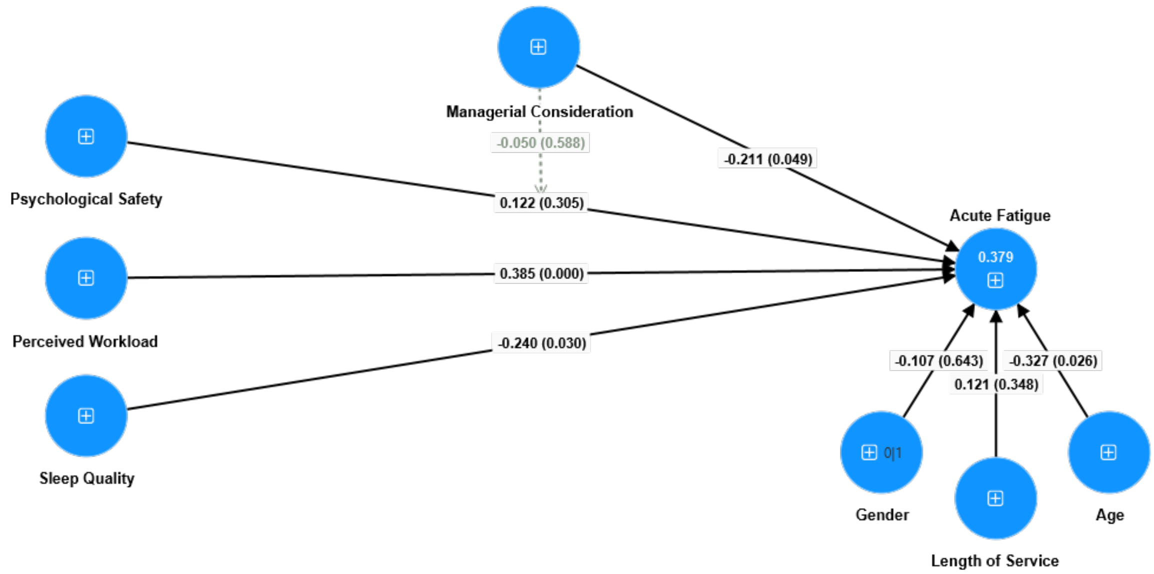
After verifying the validity of the measurement model, hypothesized relationships were evaluated by assessing the structural model. Nonparametric bootstrapping was used to assess the model's coefficient of determination, $R^{2,}$ and the statistical significance of each coefficient (Hair et al., 2019). Nonparametric bootstrapping is a method of assigning measures of accuracy to statistical estimates by computer generating large numbers of independent samples (Efron & Tibshirani, 1994). Nonparametric bootstrapping does not depend on parametric assumptions and, instead, uses complex computerized computations to provide statistical inferences on a variety of data sizes and distributions (Efron & Tibshirani, 1994).

Bootstrapping was run using 10,000 bootstrap samples as recommended by Hair et al. to ensure that the number of samples was larger than the number of valid observations found in the original data set (2022). Prior to evaluating the structural relationships of the constructs, the variance inflation factor (VIF) was examined to ensure that no collinearity that could potentially bias the regression results existed in the structural model. VIF values above five are indicative of collinearity between constructs (Hair et al., 2019). All VIF values used for the model were found to be under the limit of 5, with all except for AF.3 and AF.6 being closer to 3 and lower, as recommended by Hair et al. (2022).

The model was evaluated to determine the model's explanatory power. R^2 represents the combined effects of the exogenous variables on the endogenous variable, Acute Fatigue (AF). The R^2 for the model was .379, indicating that the model explained

37.9% of the variance in the endogenous variable, Acute Fatigue. For this study, the *p-value*, the probability of erroneously rejecting a true null hypothesis, was set at .05 as the critical value for determining significance (Hair et al., 2022). Figure 3 shows the main study model with β coefficients, the R^2 value, and *p*-values.

Figure 4 Main Study Model with Results



Hypotheses

This study sought to determine the factors contributing to acute fatigue in emergency medical services personnel in the United States. Hypothesis 1 proposed that as the psychological safety of the personnel increases, the effect on acute personnel fatigue would decrease. Employees who feel a high level of psychological safety within their organization may be more likely to raise concerns about safety and seek help when finding themselves fatigued. This relationship was not supported in this study.

Hypothesis 2 expanded upon previous research findings that found a correlation between call volume and fatigue within EMS (Crowe et al., 2018). Hypothesis 2 proposed that the effect on acute personnel fatigue will increase as the personnel's perceived workload increases. This relationship was found to be statistically significant by the study data and was supported. This finding is particularly interesting as it incorporates not only the physical workload, evidenced by call volume in previous studies but also the individual provider's workload as experienced on a psychological level, further supporting findings in prior JD-R studies.

Hypothesis 3 focused on the relationship between on-duty sleep quality and its effect on personnel fatigue. Prior research has shown 24-hour shifts may disrupt sleep patterns and duration (Hersman & Whitcomb, 2018). Additionally, research by Patterson et al. found that poor sleep quality and duration would affect providers' fatigue levels (Patterson et al., 2010). Based on extant research, hypothesis 3 focused on on-duty sleep quality and proposed that as the provider's on-duty sleep quality increases, the effect on acute personnel fatigue would decrease. Hypothesis 3 was supported by the study data, showing that sleep quality negatively affected acute personnel fatigue. This finding is consistent with and strengthens the findings of the previously mentioned research.

Hypothesis 4 focused on the effect of managerial consideration on fatigue. Managerial consideration can potentially be a resource for an employee, lowering workload. It also has the potential to be a demand, causing further strain. Administrators with low managerial concern are likely to place a higher workload on providers, disrupting the equilibrium between demands and resources and causing strain (Schaufeli et al., 2006; Stogdill et al., 1962). Conversely, administrators with high managerial consideration are likely to create a supportive environment that reduces job demands and job strain, potentially reducing fatigue (Barnes et al., 2015). Hypothesis 4 proposed that as managerial consideration increases, the effect on personnel fatigue would decrease. This relationship was found to be statistically significant and further strengthened the findings of Barnes et al, and Schaufeli et al. Hypothesis 5 proposed a moderating effect on the independent variable psychological safety such that, managerial consideration would moderate the effect of psychological safety such that as managerial consideration increases, the effect of the relationship will become stronger. As with the direct relationship between psychological safety and acute personnel fatigue, this relationship was not supported by the study findings. Table 8 lists the individual hypotheses and summarizes whether the relationship was statistically significant.

Table 8 Hypotheses Significance

	Hypothesis	**Result**	***β* and *p-value***
H1	As the psychological safety of the personnel increases, the effect on acute personnel fatigue will decrease.	Not Supported	β 0.122, p 0.305
H2	As the personnel's perceived workload increases, the effect on acute personnel fatigue will increase.	Supported	β 0.385, p <.001
H3	As the provider's on-duty sleep quality increases, the effect on acute personnel fatigue will decrease.	Supported	β -0.240, p 0.030
H4	As managerial consideration increases, the effect on acute personnel fatigue will decrease.	Supported	β -0.211, p 0.0490
H5	Managerial consideration will moderate the effect of psychological safety on acute personnel fatigue such that as managerial consideration increases, the effect of the relationship will become stronger.	Not Supported	β -0.050, p 0.588

Table 9 Main Study Total Effects

	β	ST DEV	*t* values	*p*-values
Age -> Acute Fatigue	-0.327	0.147	2.226	0.026
Gender -> Acute Fatigue	-0.107	0.231	0.463	ns
Length of Service -> Acute Fatigue	0.121	0.13	0.938	ns
Managerial Consideration -> Acute Fatigue	-0.211	0.107	1.965	0.049
Perceived Workload -> Acute Fatigue	0.385	0.097	3.96	0
Psychological Safety -> Acute Fatigue	0.122	0.118	1.027	ns
Sleep Quality -> Acute Fatigue	-0.24	0.11	2.177	0.03
Managerial Consideration x Psychological Safety -> Acute Fatigue	-0.05	0.092	0.542	ns

Note: ns= not significant

VI. IMPLICATIONS

Theoretical Implications

Fatigue in emergency medical providers is not a new research subject. However, extant studies on fatigue in emergency medical services have focused mainly on the effects of shift duration on the medical provider. Following the recommendation of previous researchers, this study sought to investigate further the potential causes of fatigue, outside of shift duration (Patterson, Weaver, Hostler, et al., 2012). By integrating Job Demands-Resources Theory, this study expanded past shift duration and focused on the effects of various demands and resources on the endogenous variable, fatigue. Job Demands-Resources Theory postulates that stress risk factors in a particular field fall into two categories: demands or resources. A disequilibrium between job demands and resources cause strain (Bakker & Demerouti, 2007). Previous research by Bakker et al. has shown that job demands were the most important antecedents of the exhaustion component of burnout (2004). This study provides support for these findings as an increase in perceived workload causes a statistically significant increase in the provider's level of acute fatigue. Similarly, high levels of managerial consideration act as a resource to personnel, helping balance the rigorous demands of the job, reducing strain, exhaustion, and acute fatigue. This relationship between managerial consideration and acute fatigue further strengthens existing understandings of JD-R theory and the importance of a balance between job demands and resources to reduce acute fatigue.

Furthermore, prior studies show a statistically significant link between the prevalence of fatigue-related events and disruptions in a person's sleep pattern (Buysse, 2018). The study highlighted that on-duty sleep quality is a significant factor affecting acute fatigue in emergency medical services providers. These findings further strengthen existing understandings about sleep quality and highlight the need for a greater understanding of how to improve a provider's sleep quality while subsequently ensuring efficient service delivery. In an environment where disruptions in the sleep cycle may be unavoidable, it becomes necessary to develop other methods of improving sleep quality without affecting a provider's availability to respond to emergency situations.

The study further contributes to our understanding of psychological safety and its role in fatigue reduction. This study failed to find significance in the relationship between psychological safety and fatigue, indicating that providing an environment where people feel empowered and safe to voice concerns when they do not feel safe is not sufficient in and of itself to reduce fatigue. This is contradictory to previous findings in other industries that found a reduction in exhaustion and burnout in teams that have a high level of psychological safety.

Practical Implications

Administrators of EMS organizations have the daunting task of ensuring service delivery to those in need of acute and often life-saving medical issues in a timely manner while operating in a world that requires adequate coverage 24 hours a day, seven days a week. This service demand often leads to personnel needs being placed secondary to service delivery requirements. It is tempting for administrators and policymakers to attempt to reduce provider fatigue by making decisions based on anecdotal evidence or industry tradition. It is this behavior that Patterson et al. cautioned policymakers to refrain from making (Patterson, Higgins, Dongen, et al., 2018). Deployment decisions in the absence of further research into the causal factors of fatigue may not only be ineffective, but they may also be detrimental to the operations of the organization and provider safety and well-being (Patterson, Higgins, Dongen, et al., 2018)

This research helps to bolster existing research that illustrates the danger of fatigue in EMS providers and highlights to agency policymakers that factors exist beyond shift length that contribute to the fatigue landscape. This information can help expand policymakers' understanding of the complex role that seemingly unrelated factors like managerial consideration play in reducing overall acute fatigue on their providers while simultaneously empowering them to engage in change practices that will mitigate fatigue using nontraditional methods that have failed in the past.

The findings of this study can also be used to help develop tools that can routinely measure these previously overlooked factors of fatigue. Using those tools to regularly and consistently monitor those factors can lead to implementing provisions that reduce them will ultimately improve medical care delivery to patients while improving provider safety (Maghsoud et al., 2022).

The lack of support for psychological safety as a factor for reducing acute fatigue highlights the importance of taking a multifaceted approach to fatigue mitigation specific to emergency medical services. Providing a safety-supportive environment where people are free to voice concerns without fear of negative retribution may be sufficient in other industries, but this study highlights that it is not sufficient on its own to mitigate acute fatigue in the emergency medical services arena. It is important for policymakers to understand that mitigation strategies are not applicable across every industry. Policymakers must tailor mitigation strategies to their employees' needs and the environment they operate within.

VII. STUDY LIMITATIONS AND FUTURE RESEARCH

This study focused on a cross-sectional sampling of random participants in the emergency medical services field to determine whether certain factors had a causal link to acute fatigue. In a future study, it would be beneficial to take a longitudinal approach with a set group of study participants. A longitudinal study would enable researchers to take a more granular approach to understanding how changes in each latent variable affect fatigue over time. This approach may result in more conclusive results that may provide better insight into the potential interactions of the various latent variables not hypothesized in this study.

The focus of this study was limited to acute fatigue during the shift prior to the survey. Although this focus is useful for understanding specific demands that cause acute strain during one period of time, researchers have widely documented that repeated exposure to stressors has the potential to lead to increased chronic fatigue and chronic fatigue syndrome (Wyller, 2007). Additionally, researchers have identified that as increased chronic fatigue occurs, it may be more difficult to recover between shifts, and thus, the effects of various job demands may become exacerbated (Winwood et al., 2005). Future researchers could choose to focus on the cumulative effects of fatigue over time and how the cumulative nature of fatigue changes the body's ability to recover and process acute stressors.

This study measured perceived workload in a more general sense. Future researchers may benefit from exploring perceived workload in a more granular fashion.

Understanding how various job demands factor into overall perceived workload may reveal new insights into how to reduce perceptions of workload and overall fatigue.

This study showed in a limited manner that sleep quality is causally related to acute fatigue. The study fails to elaborate on the various aspects of sleep quality and how those individual aspects can be manipulated to increase sleep quality in the absence of removing disruptions caused by service delivery. Future research could focus on how manipulating various sleep quality factors affects overall acute and chronic fatigue and highlight strategies that can be used in lieu of greater quantities of sleep.

Finally, psychological safety failed to prove a significant factor causing acute fatigue during this study. Considering the importance of psychological safety in other industries, future research should be considered to expand the understanding of the role that psychological safety plays in the overall fatigue picture. It is possible that the limited scope of this study failed to adequately capture the importance of this construct in the realm of emergency medical services.

VIII. CONCLUSION

This study explored the factors that contribute to acute fatigue in emergency medical services personnel in the United States. In the high-acuity, high-consequence world of emergency medical services, decisions often mean the difference between life and death. With no clear understanding of the myriad of factors that contribute to acute fatigue in emergency medical services providers and a call to action from extant researchers to study the phenomenon further while simultaneously cautioning policymakers to refrain from making deployment decisions in the absence of further research, it is imperative that researchers focus on understanding how increased demands and decreased resources contribute to provider fatigue (Patterson, Higgins, Dongen, et al., 2018).

The study used a multistep quasi-experimental quantitative approach to identify these causal factors and understand their role in contributing to provider fatigue. Through rigorous scientific methodology, this research helped further our understanding of Job Demands-Resource Theory, Managerial Consideration, and Psychological Safety.

Fatigue in any industry is complex, and mitigating fatigue meaningfully while ensuring service demands are met in a world that requires immediate response to life-threatening situations can be incredibly difficult for administrators and field providers alike. This research represents a small step forward in ensuring that emergency medical services providers are able to operate in a safe and efficient manner that allows for optimal patient care delivery in an environment built on a foundation of safety, accountability, and reduced liability.

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APPENDICES

Appendix I Primary Pilot Information Letter

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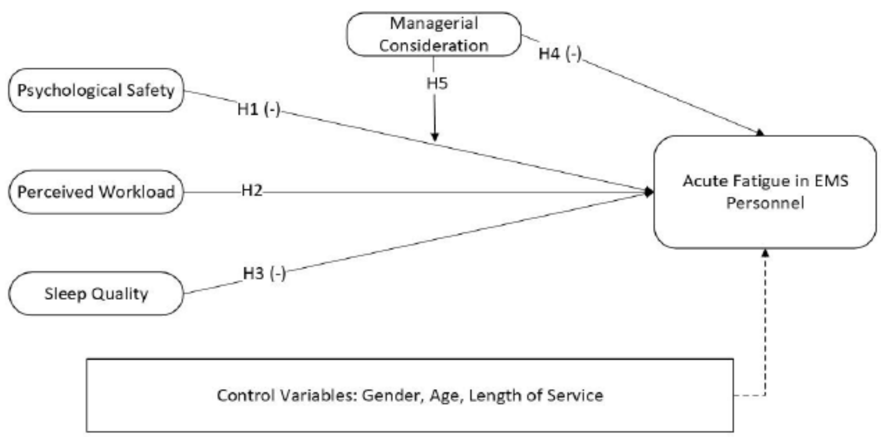
Dear Informed Pilot Participant,

Thank you for taking the time to participate in this informed pilot for my dissertation research looking at the causal factors of acute fatigue in emergency medical services providers.

Unlike other high-consequence industries, emergency medical services lack practical guidance on reducing provider fatigue. Due to the 24-hour-a-day, seven-day-a-week nature of service requirements on agencies, providers are often placed in situations where they are subjected to making lifesaving decisions while fatigued. Much of the extant literature regarding fatigue in EMS focuses on shift duration as the primary causal factor without exploring additional potential causal factors that may contribute to fatigue. While there is little doubt that shift duration plays a significant role in fatigue, the causal factors of fatigue in emergency medical services are more extensive than extant research has provided support for. This research seeks to understand the factors that contribute to acute fatigue in emergency medical services personnel in the United States.



This study will test the effects of psychological safety, perceived workload, sleep quality, and managerial consideration on acute fatigue in EMS personnel. Data will be collected from a random sample of providers using primary survey data collected through Qualtrics.

In conjunction with other pilot team members, you will be evaluating the survey instrument that will be used to collect data for my dissertation research.

The survey instrument has a total of 50 questions in 9 different sections:

1. 5 qualifying questions
2. 4 demographic questions

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3. 5 questions that measure chronic fatigue
4. 5 questions that measure managerial consideration
5. 6 questions that measure acute fatigue
6. 5 questions that measure psychological safety
7. 10 questions that measure sleep quality
8. 4 questions that measure intershift recovery
9. 6 questions that measure perceived workload

As an informed pilot member, please consider the following potential issues while evaluating each of the 50 questions:

• Is the question clear and understandable?
• Is the question targeted to emergency medical services providers?
• Does the question rightly measure the variable of interest?
• Is the question double-barreled? Double Barreled Questions cover more than one topic. "And" or "or" within a question usually makes it double-barreled.
• Is the question leading? A leading question suggests to the respondent that the researcher expects or desires a particular answer.
• Is the question loaded? A loaded question asks the respondent to rely on their emotions more than the facts. Loaded questions contain "emotive" words with a positive or negative connotation.
• Is the question confusing? A confusing question lacks clarity making it difficult for the respondent to comprehend the question in the desired/required manner.
• Is the question ambiguous? An ambiguous question is open to more than one interpretation and has a double meaning.
• Is the question easy to understand and answer? If the respondent can easily understand and answer the question using the provided response choices.

You can access the informed pilot survey at the following link:
https://tinyurl.com/dissertationpilot

If you have any questions or want to talk about any of your observations, please do not hesitate to reach out to me at 239-340-8839 or by email @ rbert025@fiu.edu. Thank you in advance for your help with my dissertation research.

Rob Bertulli

Florida International University
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Appendix II Study Survey Instrument

Personnel Enervation in Emergency Medical Services

FIU Business
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INFORMATIONAL LETTER
Personnel Enervation in Emergency Medical Services

Hello, my name is Robert Bertulli. You have been chosen at random to be in a research study about fatigue in emergency medical services. This study aims to study fatigue in emergency medical service providers. If you decide to be in this study, you will be one of 400 people in this research study. Participation in this study should take less than 10 minutes of your time. If you agree to be in the study, I will ask you to answer a series of questions by completing an online survey.

There are no foreseeable risks or benefits to you for participating in this study. This study is expected to benefit society by helping researchers make EMS safer for providers and patients by helping reduce fatigue in EMS providers.

There is no cost or payment to you. If you have questions while taking part, please stop and ask.

You will remain anonymous and will not be asked identifying questions.

If you have questions for one of the researchers conducting this study, you may contact Robert Bertulli at 941-312-1710.

If you would like to talk with someone about your rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop. You may keep a copy of this form for your records.

- ❍ Continue to survey
- ❍ Exit survey

QUAL.1 How old are you?

- ❍ Under 18
- ❍ 18-24 years old
- ❍ 25-34 years old
- ❍ 35-44 years old
- ❍ 45-54 years old
- ❍ 55-64 years old
- ❍ 65+ years old

QUAL.2 Do you work at an agency that provides emergency medical services in the United States?

- ❍ Yes
- ❍ No

QUAL.3 What type of EMS agency do you work for?

- ❍ Government ambulance service (EMS only)
- ❍ Fire or police linked service (Fire Rescue, etc)
- ❍ Private ambulance service
- ❍ Hospital-based ambulance service
- ❍ Volunteer ambulance service
- ❍ Other not listed (please type in)

____

QUAL.4 What is your level of professional certification?

- Emergency Medical Responder (EMR)
- Emergency Medical Technician (EMT-B, NREMT)
- Advanced Emergency Medical Technician (NRAEMT)
- Paramedic (EMT-P, NRP)
- Nurse (LPN, RN)
- Physician (DO, MD)
- Other (Please write in your credential)

____

QUAL.5 How would you describe the response level of the ambulance you work on?

- Advanced Life Support
- Basic Life Support
- Critical Care
- Other (Please describe below)

____

DEM.1 How long have you worked in EMS?

- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- Greater than 20 years

DEM.2 How do you describe yourself?

- Male
- Female
- Non-binary / third gender
- Prefer to self-describe

____

DEM.3 What is the highest level of education you have completed?

- Some high school or less
- High school diploma or GED
- Some college, but no degree
- Associate or technical degree
- Bachelor’s degree
- Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS, etc.)
- Prefer not to say

DEM.4 How long has it been since your last shift ended?

- Less than one hour
- 1-2 hours ago
- 2-3 hours ago
- 3-4 hours ago
- 5-6 hours ago
- 6-7 hours ago
- 7-8 hours ago
- 8-24 hours ago
- Greater than 24 hours ago

MC.1-5 Please answer each question as accurately as possible

	Never	Very Rarely	Rarely	About Half the Time	Frequently	Very Frequently	Always
My supervisor finds time to listen to me	❍	❍	❍	❍	❍	❍	❍
My supervisor looks out for my personal welfare	❍	❍	❍	❍	❍	❍	❍
My supervisor treats me as an equal	❍	❍	❍	❍	❍	❍	❍
My supervisor is willing to make changes	❍	❍	❍	❍	❍	❍	❍
My supervisor puts my suggestions into operation	❍	❍	❍	❍	❍	❍	❍

AF.1-6 Please answer each question as accurately as possible	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I usually have plenty of energy to give my family	❍	❍	❍	❍	❍	❍	❍
I have energy for my hobbies in my spare time	❍	❍	❍	❍	❍	❍	❍
I have plenty of reserve energy when I need it	❍	❍	❍	❍	❍	❍	❍
I usually recover my energy within a few hours of getting home from work	❍	❍	❍	❍	❍	❍	❍
I have energy for relaxing activities in my spare time	❍	❍	❍	❍	❍	❍	❍

I usually have plenty of energy to give my friends	❍	❍	❍	❍	❍	❍	❍

PS.1-5 Please answer each question as accurately as possible

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
If I make a mistake at work, it is often held against me	❍	❍	❍	❍	❍	❍	❍
Members of my department /company are able to bring up problems and tough issues	❍	❍	❍	❍	❍	❍	❍
People at my department /company sometimes reject others for being different	❍	❍	❍	❍	❍	❍	❍
It is difficult to ask other	❍	❍	❍	❍	❍	❍	❍

members of my department /company for help							
Working with members of my department /company, my unique skills and talents are utilized	❍	❍	❍	❍	❍	❍	❍

SQ.1 Are you normally permitted to sleep while on duty?

- ❍ No
- ❍ Yes
- ❍ Occasionally

SQ.2 Were you able to sleep during your last shift?

- ❍ Yes
- ❍ No

GTS .Info. Each question is answered by clicking one of the 9 radio buttons in the line. If no change was experienced then click the number 5 button in the middle. If a change was experienced then the position of your choice will indicate the nature and extent of the change, i.e., large changes near the ends, small changes near the middle.

SQ.GTS.3-5 How would you compare getting to sleep on duty with getting to sleep normally, i.e. at your home?

	1	2	3	4	5 (No change)	6	7	8	9	

Easier than usual	❍	❍	❍	❍	❍	❍	❍	❍	❍	Harder than usual
Quicker than usual	❍	❍	❍	❍	❍	❍	❍	❍	❍	Slower than usual
Felt more drowsy than usual	❍	❍	❍	❍	❍	❍	❍	❍	❍	Felt less drowsy than usual

SQ.QOS.6-7 How would you compare the quality of sleep on duty with off duty (your usual) sleep?

	1	2	3	4	5 (No change)	6	7	8	9	
More restful than usual	❍	(	(	(	❍	(	(	❍	❍	Less restful than usual
Fewer periods of wakefulness than usual	❍	(	(	(	❍	(	(	❍	❍	More periods of wakefulness than usual

SQ.AFS.8-9 How did your awakening after sleeping on duty compare with your usual pattern of awakening?

	1	2	3	4	5 (No change)	6	7	8	9	

Easier than usual	❍	❍	❍	❍	❍	❍	❍	❍	❍	More difficult than usual
Took shorter than usual	❍	❍	❍	❍	❍	❍	❍	❍	❍	Took longer than usual

SQ.BFW.10 How did you feel when you woke up on duty?

	1	2	3	4	5	6	7	8	9	
Alert	❍	❍	❍	❍	❍	❍	❍	❍	❍	Tired

PW.1-3 Please answer each question as accurately as possible

	Very Low	Moderately Low	Slightly Low	Moderate	Slightly High	Moderately High	Very High
How mentally demanding was your last shift?	❍	❍	❍	❍	❍	❍	❍
How physically demanding was your last shift?	❍	❍	❍	❍	❍	❍	❍
How hurried or rushed was the pace of your last shift?	❍	❍	❍	❍	❍	❍	❍

PW.4 Please answer each question as accurately as possible

	Complete Success	Moderate Success	Slight Success	Neither a Success or a Failure	Slight Failure	Moderate Failure	Complete Failure
How successful were you in accomplishing what you were tasked with doing during your last shift?	❍	❍	❍	❍	❍	❍	❍

PW.5-6 Please answer each question as accurately as possible

	Very Low	Moderately Low	Slightly Low	Moderate	Slightly High	Moderately High	Very High
How hard did you have to work to accomplish your level of performance?	❍	❍	❍	❍	❍	❍	❍
How insecure, discouraged, irritated, stressed, and annoyed were you during your last shift?	❍	❍	❍	❍	❍	❍	❍

VITA

ROBERT ANTHONY BERTULLI

2009	A.S., Emergency Medical Services Technology Edison State College Fort Myers, Florida
2019	B.A.S., Public Safety Administration Florida SouthWestern State College Fort Myers, Florida
2020	Certified Public Manager Florida State University Tallahassee, Florida
2020	M.B.A., Management Barry University Miami, Florida
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