EVALUATING FITNESS-FOR-DUTY

FIRE SERVICE FINANCIAL MANAGEMENT

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An applied research project submitted to the National Fire Academy
as part of the Executive Fire Officer Program

November 2001

ABSTRACT

This applied research project analyzed the problem of evaluating fitness-for-duty in the Los Angeles Fire Department (LAFD). The problem was that the LAFD did not have a simple effective method for evaluating the fitness-for-duty of members working multiple consecutive shifts. The purpose of this applied research project was to evaluate nationally and/or internationally recognized procedures and technologies used to evaluate a person's fitness-for-duty.

This research project employed the evaluative research methodology to identify:

1. What nationally and/or internationally recognized procedures and/or technologies are used to evaluate a person's fitness-for-duty?
2. What were the potential benefits and drawbacks of adopting and implementing procedures and/or technologies to evaluate a person's fitness-for-duty?
3. What factors would prevent the LAFD from implementing procedures and/or technologies to evaluate a person's fitness-for-duty?
4. What procedures and/or technologies were other fire service agencies using to evaluate the fitness-for-duty of line personnel working multiple shifts?

The principle procedures employed in this research project were: a review of the literature on sleep and alertness, fatigue, shift-work, and fitness-for-duty evaluation methods and technologies; a survey of the Los Angeles County fire-based EMS providers regarding fit-for-duty policies and procedures; an evaluation of the methods and technologies currently used to evaluate fitness-for-duty in other industries; and interviews with scientists currently working in the field of fatigue evaluation.

The major findings of this research were that: sleep disruption and sleep deprivation may result from shift-work; sleep debit is cumulative and performance is only restored through sleep; work schedules and consecutive hours worked are major components of stress and fatigue in the workplace; stress and fatigue can lead to mistakes; daily duty schedules, overtime policies, and fitness-for-duty evaluation methods should take into account the existence of fatigue and that countermeasures are needed to ensure the health and safety of both the public and the workforce; the technology-based tools currently available for evaluating and documenting fitness to work are either not practical for daily use in a field setting or they produce an unacceptably high rate of false positives and false negatives and therefore are not in wide-spread use in any industry.

The recommendations resulting from this research were that the LAFD should:

1. Begin collecting and analyzing complaint and mistake data in terms of hour-of-day, day-of-week, month, season, workload, and consecutive hours worked.
2. Work with the labor organizations to develop daily duty schedules that take into account the effects of sleep disruption and sleep deprivation by implementing counter measures that effectively combat the short-term and long-range impact of fatigue.
3. Work with the labor organizations to develop overtime policies and fitness-for-duty evaluation methods that ensure the health and safety of both the public and the workforce.
4. Work with the labor organizations to develop work policies and environments that take into account the importance of regular restorative sleep when unusual duty hours are required.

5. Work with the labor organizations to develop training and management plans that integrate sleep hygiene, nutrition, motivation, and operational requirements into a Crew Endurance Management (CEM) system.
6. Seek funding to conduct a systematic study on the rational design and evaluation of polyphasic sleep/wake patterns as potential solutions to sleep management under prolonged work requirements.
7. Seek funding to conduct a trial study of the technologies currently available to evaluate fitness-for-duty using firefighters and paramedics as subjects.

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INTRODUCTION

The Los Angeles Fire Department (LAFD) uses an overtime hiring policy that limits the number of consecutive hours that may be worked to determine when a member is allowed and/or may be required to work multiple consecutive shifts. This policy does not take into account the actual number of hours the member has been awake, the activities that the member was engaged in during those hours, or the amount of sleep the member has had during a 24-hour work shift.

The problem is that the LAFD does not have a simple effective method for evaluating the fitness-for-duty of members working multiple consecutive shifts. The purpose of this applied research project is to evaluate the nationally and/or internationally recognized procedures and technologies used to evaluate a person's fitness-for-duty.

This research project will employ the evaluative research methodology to answer the following questions:

1. What nationally and/or internationally recognized procedures and/or technologies are used to evaluate a person's fitness-for-duty?
2. What are the potential benefits and drawbacks of adopting and implementing procedures and/or technologies to evaluate a person's fitness-for-duty?
3. What factors would prevent the LAFD from implementing procedures and/or technologies to evaluate a person's fitness-for-duty?
4. What procedures and/or technologies are other fire service agencies using to evaluate the fitness-for-duty of line personnel working multiple shifts?

BACKGROUND AND SIGNIFICANCE

The issue of fitness-for-duty relative to consecutive hours worked was brought to the attention of the Los Angeles County Emergency Medical Services (EMS) Commission in January 2000.

The Fire Chief of the Los Angeles Fire Department presented the Commission with an overview of a proposed “One-plus-One” staffing trial program for the San Fernando Valley, a geographically isolated area that represents one-third of the Department’s response area. The primary goal of the program was to improve EMS operations by reducing the Advanced Life Support (ALS) response time to each fire station district. The Chief proposed to accomplish this goal in two ways. The first, was to deploy at least one ALS unit in each fire station. At the time of the original proposal, 5 of the 35 fire stations in the Valley did not have any ALS capability. The second, was to increase the total number of ALS resources. At that time there were only 15 ALS ambulances serving the 35 districts in the Valley and only 16 of the 35 engine companies were staffed with firefighter/paramedics. The One-plus-One staffing plan would have placed a firefighter/paramedic on each engine company and thereby increased the number of ALS resources from 31 to 53. It would also have reduced response times by simplifying the dispatch algorithms used to determine the types of resources that were sent to EMS incidents.

To meet the objectives of the program, the Chief needed approval from the Los Angeles County EMS Agency and the EMS Commission to change the required staffing on ALS units. The Los Angeles County Department of Health Services (DHS) staffing policy required that ALS units be staffed with two paramedics (1979, Ref. # 408). The Chief’s proposal called for staffing ALS units with one paramedic and one EMT, but dispatching two ALS units to each ALS level call so that there would be two paramedics on scene to provide patient care.

One of the reasons underlying the Chief's staffing proposal was a shortage of paramedic personnel filling ALS positions. In January of 2000, there were 412 paramedics filling 459 authorized positions. However, there were an additional 45 paramedics working on Basic Life Support (BLS) units. The Chief felt that if the EMS workload could be more evenly distributed between the engines and ambulances, then many of the paramedics working on BLS companies could be drawn back onto ALS resources and more firefighters would volunteer for paramedic training.

The One-plus-One staffing plan would have significantly altered the traditional working relationships that had developed between paramedics and firefighters over a 30-year period. During the public comment period, which followed the Chief's presentation, numerous paramedics and firefighters voiced their concerns about the program. The paramedics were accustomed to working with a regular partner that had the same level of training. The paramedics felt that working with an EMT partner that had only 120 hours of medical training, compared to their paramedic partner's over 1200 hours of medical training, would increase their stress level and jeopardize patient care. The firefighter/EMTs were equally concerned. Although they felt comfortable performing BLS support functions on ALS incidents, they did not feel sufficiently trained to work as a regular partner with a paramedic. The firefighters also voiced concerns about increased stress and jeopardizing patient care. Both firefighters and paramedics testified about fatigue caused by forced overtime and that being required to work extra shifts was adversely impacting patient care.

These appeals raised the concern of the Commission that fatigue-related mistakes were putting patients at risk. Similar concerns were also raised in the local press by paramedics and firefighters speaking out against the staffing plan. The Commission responded by directing the

EMS Agency staff to develop a draft overtime policy that limited consecutive hours worked. This document was to be reviewed and discussed by each of the EMS Commission sub-committees and then brought back to the Commission for action.

The initial draft policy (Appendix A) limited the number of consecutive hours worked by both EMTs and paramedics to maximum of 72 hours with a minimum of 3 hours uninterrupted sleep in any 24-hour work period. This draft policy represented a significant change in the work rules that had been negotiated by labor and management in all of the fire departments in Los Angeles County. As a result, both labor and management representatives testified during the public comment period of the May 2001 Commission meeting that the EMS Agency had exceeded their scope in developing a policy that impacted wages, hours, and working conditions which are covered under a collective bargaining agreement. In response to this testimony and pressure from the fire-based EMS provider agencies, the Commission established a task force to evaluate the impact of fatigue on fitness-for-duty.

LITERATURE REVIEW

The historical overview of the fitness-for-duty issue was derived from a review of unpublished internal LAFD documents and minutes of Los Angeles County EMS Commission meetings. The literature reviewed for this applied research project consisted of books, journal articles, and technical publications that addressed sleep and alertness, fatigue, shift-work, and fitness-for-duty evaluation methods and technologies.

The military has long recognized that man is increasingly the limiting element in the man-machine system. During a deployment, military personnel must often operate for several days in a high-risk environment with little or no sleep. Military leaders recognized that to make optimum use of their limited resources during combat operations, it was necessary to be able to

accurately predict the likely behavior of personnel under sleep deprived conditions, so that procedures and equipment could be designed to minimize the effects of sleep loss (Allnutt, Haslam, Rejman, and Green, 1990, p. 529).

Some of the early research on the effect of sleep loss demonstrated that the primary impairment during acute sleep loss takes the form of lapses or microsleeps. As sleep loss time is prolonged, the lapses become longer and more frequent. In the early stages of acute sleep loss, speed of performance on self-paced tasks such as problem solving, making judgments, and issuing orders is impaired by sleep deprivation, but task accuracy can be sustained with extra effort. However, on time- or work-paced tasks with a high vigilance component, where the subject cannot control the time of appearance or duration of the stimulus and must respond quickly, lapses cause an increase in errors of omission (Bergstrom, 1972, p. 54).

In 1963, the U. S. Army Combat Development Command Armor Agency requested the Human Resources Research Organization (HumRRO) to study the effects of continuous operations on armor personnel. “The specified research objectives were: 1) to determine troop combat effectiveness as it is affected by fatigue resulting from continuous combat operations, and 2) to determine changes in unit organization and tactical doctrine that would reduce or eliminate causes of fatigue” (Ainsworth and Bishop, 1971, p. v).

Although more than one thousand reports were screened, the literature review did not provide any clear-cut answers to questions about probable effectiveness of troops operating continuously for 48 hours or more. The experimental evidence was meager and there were conflicting conclusions as to the effects of prolonged activity on task performance. Because of important differences between motivation in the laboratory and in “real life” field situations, it

was decided that generalizations based on laboratory studies could not be applied to combat-type situations.

The researchers developed and conducted field exercises that combined the realism of combat operations with the attention to data collection details that was possible in the laboratory. The HumRRO study determined that “in comparison with the control group, the experimental group exhibited little performance decrement in the communication, gunnery, and maintenance exercises and in two of the four driving exercises. However, the performance of the experimental group was significantly worse than that of the control group in moving surveillance and in the other two driving exercises” (Ainsworth and Bishop, 1971, p. v).

The Army concluded that, although activities that demand a high level of alertness or require complex perceptual-motor activity were the most sensitive to the adverse effects of sleep loss, under field conditions, crews were able to perform without serious performance decrements during a 48-hour period without sleep and changes in unit organization or tactical doctrine were not required (Ainsworth and Bishop, 1971, p. vi).

In 1984, Haslam reported on the results of two field exercises that evaluated the military performance of soldiers in sustained operations. He determined that “the main effect of sleep deprivation was psychological rather than physiological. Mental ability and mood deteriorated, whereas bodily mechanisms coped adequately” (p. 217). He also reported that “tasks with a cognitive and vigilance component began to deteriorate after one night without scheduled sleep. After three nights without sleep, performance had deteriorated to approximately 50% of control values” (p. 219). The military observers of the exercises judged the soldiers to be ineffective in a defensive role after 48 hours without sleep (p. 220). However, after 4 hours of uninterrupted sleep, the soldiers performance was considerably improved, as was their mood. Haslam

concluded that a small amount of recovery sleep, relative to the amount of sleep lost, has very beneficial effects on both mood and performance (p. 221).

Rognum et al. (1986) reported similar findings after studying the effect of high- and low-energy diets during prolonged heavy exercise combined with sleep deprivation. Regardless of type of diet, after only 24 hours of sustained activity, the military effectiveness of the subjects had declined; this trend continued until the fourth day, when all subjects were considered to be ineffective as soldiers. The authors concluded that the major factor influencing the performance and well being of their subjects, during sustained operations, was sleep deprivation rather than the sustained physical activity and that reducing the energy deficit through a high carbohydrate diet did not prevent the decline in military effectiveness (p. 865).

During Operations Desert Shield and Desert Storm in 1990/91, aircrews were exposed to extended work hours, reduced sleep hours, night work, and circadian disrhythmia caused by shift-work and time-zone crossing (Neville, Bisson, French, Boll, and Storm, 1994, p. 340). Crew rest and flight hour limitations were very general and did not take into account sleep history, duty day cycles, mission cycling, aircrew history, cumulative fatigue, local billeting conditions, or circadian dysrhythmia affects on crew rest requirements (Bisson, Lyons, and Hatsel, 1993, p. 848). The authors of both studies recommended development of a training and management plan that integrated sleep hygiene, nutrition, motivation, and operational requirements into an alertness or fatigue management system. Neville et al. (1994, p. 339) recommended that work policies and environments be designed to take into account the importance of regular restorative sleep when unusual duty hours are required.

While the predominant sleep pattern of adults in industrialized societies is monophasic, Stampi (1989) concluded from studies of transoceanic yacht racers that “highly motivated

individuals (and/or people under particularly extreme task demands) adapt to ultrashort sleep/wake patterns without great difficulty, for relatively long periods, and can maintain (at least for the task at hand) high levels of efficiency when doing so" (p. 163). The author further suggests that although "the evidence strongly suggests that humans are able to adapt to fragmented sleep patterns, no systematic study has yet been conducted on the rational design and evaluation of polyphasic sleep/wake patterns as potential solutions to sleep management under prolonged work requirements" (p. 164).

Sleep researchers have determined through field studies of continuous work that the capacity to store sleep is extremely rare. "There appears to be no way to restore performance effectiveness during continuous work without permitting individuals to sleep, and short periods of sleep, namely naps, are disproportionately effective for recovery of functioning. Despite the benefits of occasional naps, performance and mood under such conditions are still far from 100% baseline optimal levels, especially when the nap is taken after a more or less pronounced amount of sleep debit has been accumulated" (Stampi, 1989, p. 143).

However, studies on the effectiveness of nap sleep in improving performance have yielded conflicting results. Naitoh and Angus (1989, p. 225) suggest that the time when a nap is taken may influence its effect on behavior and mood. In laboratory experiments, early morning naps (0400 to 0600 hours) resulted in severe and prolonged sleep inertia and did not have any recuperative power, whereas midday naps (1400 to 1600 hours) produced relatively short sleep inertia and had clear recuperative power. Natioh and Angus (1989, p. 226) further suggest that sleep inertia may be more severe around the circadian nadir and less severe near the circadian peak in alertness. Thus, the immediate recuperative benefits of nap sleep may be masked by sleep inertia. However, field studies conducted by Opstad et al. and Haslam determined that

sleep of 3 to 4 hours in the early morning, after prolonged wakefulness, had a marked beneficial effect on both mood and performance of soldiers (Haslam, 1983, p. 362).

Natioh and Angus (1989) contend that the infrastructure of the nap may play a role in sleep inertia. “The first four hours of a normal eight-hour sleep period is predominately short wave sleep (SWS), whereas the second four hours is predominately rapid eye movement (REM) and stage two sleep. The minimum nocturnal sleep duration for performance maintenance is between four and five hours, which suggests that SWS may play an important role in nap benefits” (p. 227). The authors further state that “although NREM sleep in general and SWS in particular may be associated with the severity of sleep inertia upon awakening, there is no compelling evidence that any one sleep stage is associated with the recuperative value of sleep. Experimental findings obtained at the Naval Health Research Center indicate that sleep stages 2, 3, 4, and REM sleep are all equally recuperative” (p. 227).

Åkerstedt, Torsvall, and Gillberg (1989) concluded from their studies of shift-work and naps that “napping is wide-spread. It occurs in relation to night and morning shifts (i.e., when sleep has been disturbed by the shift system). Reasons for napping among shift-workers are response to fatigue and prevention of fatigue, and the timing of naps appears to be determined by circadian and ultradian sleep regulation. Occasionally, napping may have negative effect on the shift-workers’ [normal] sleep pattern” (p. 217).

Other studies of shift-workers have focused on the health consequences of the sleep deprivation, which can result from shift-work. Hossain and Shapiro (1999) report that “the most direct and consistent effect of carrying out shift-work is the impairment of the quality and quantity of sleep at unusual hours during workdays and non-workdays, and this sleep debit appears to have cumulative effect on the individual’s tolerance. Circadian desynchronization

may occur with rapid rotating shift schedules, rapid time-zone changes, or unorganized sleep-wake cycles. The adverse effects of shift-work can manifest themselves in the short term as sleep disturbances, shift-lag syndrome, fatigue, errors, accidents, and psychosomatic troubles. In the long term, there is an increased risk for chronic fatigue, gastrointestinal problems, depression, and cardiovascular diseases" (p. 294).

Richardson, Miner, and Czeisler (1995) reported that "the repeated changes in sleep-wake cycles, meal times, and work times inherent in rotating shift schedules conflict with the dictates of the inherent biological clock and have adverse consequences for the health of the shift-work population. An important consequence of this conflict is impaired performance, both on and off the job, as indexed by the increase of motor vehicle accidents in shift-workers" (p. 265).

The Association of Professional Sleep Societies' Committee on Catastrophes, Sleep, and Public Policy evaluated scientific and technical reports on the distribution of medical incidents (such as heart attack and stroke) and performance failures (such as vehicular accidents and human errors in industrial operations that can affect public safety) throughout the 24-hour day. The committee found that "these events occur most often at times of day coincident with temporal pattern of brain processes associated with sleep" (Mitler et al., 1988, p. 100). The authors discovered that "the neural processes controlling alertness and sleep produce an increased sleep tendency and a diminished capacity to function during certain early morning hours (circa 2-7 a.m.) and, to a lesser degree, during a period in the midafternoon (circa 2-5 p.m.) whether or not we have slept" (p. 101). When fatigue resulting from sleep deprivation and/or sleep disruption is superimposed on this normal, two-peak pattern of sleep vulnerability, the

danger of an error due to sudden overwhelming sleepiness increases and it progresses with continued sleep loss or sleep debit.

Dinges (1995) reported that “there is an emerging recognition that neurobiologically-based sleepiness/fatigue contributes to human error as a root cause of many accidents in industrialized societies, and that prevention of such fatigue-related accidents should receive a higher priority in public-policy debates about safety” (p. 4). The author cites several well-known high-consequence disasters, which occurred at night. The list includes the Three Mile Island nuclear power plant incident in 1979; the pesticide plant disaster in Bhopal, India in 1984; the Chernobyl nuclear power plant explosions in 1986; and the grounding of the oil tanker Exxon Valdez in 1989. “The primary human mistake contributing to many of the high-consequence disasters that occurred on the night shift has involved errors of vigilance” (p. 7).

“The National Highway Traffic Safety Administration (NHTSA) estimates that drowsy drivers cause 100,000 traffic accidents each year, in which 1,500 people are killed and 71,000 are injured” (Howle, 2001, p. 1). Other studies have equated drowsy driving with drunk driving. Dawson and Reid (1997) determined that sustained wakefulness of 17 hours decreased performance about as much as a blood alcohol concentration (BAC) of 0.05 and 24 hours without sleep corresponds to a BAC of 0.10. They concluded that “relatively moderate levels of fatigue impair performance to an extent equivalent to or greater than is currently acceptable for alcohol intoxication” (p. 1). In California it is illegal to drive with a BAC of 0.08 or more. For drivers of commercial vehicles the legal limit is 0.04 (Department of Motor Vehicles [DMV], 1997, DL 606).

It appears that wide ranges of catastrophic phenomena are influenced by sleep-related processes in ways not previously appreciated. For example, Mitler et al. (1988) reported that

death has also been shown to occur most often near the sleepiness zone. A major peak occurs between 4 a.m. and 6 a.m. with a smaller peak between 2 p.m. and 4 p.m. A study of heart attack deaths reflect the same bimodal pattern throughout the 24-hour day as sleep tendency and mortality data, although there is a 1- to 2-hour phase delay in peak incidents (p. 103). When fatigue-related vehicular accident data is evaluated as a function of time of day a similar bimodal distribution is revealed with peak occurrences between 1 a.m. and 7 a.m. Studies of human performance, errors, and accidents in work settings reflect a similar bimodal pattern with a major peak between 2 a.m. and 4 a.m. and a minor peak between 2 p.m. and 4 p.m. (Mitler et al., p. 105). As first responders to these types of incidents, fire departments should take these findings into account when developing deployment, training, and duty schedules.

The literature clearly shows that “although there is considerable variation among individuals, on average, workers require 7.5 to 8.5 hours of sleep per day. Workers obtaining less than their required amount of sleep develop a sleep debit that is cumulative. The poorest job performance consistently occurs at night and the highest rate of industrial accidents is usually found among shift-workers. Employers must recognize that work outside of normal daylight work hours and extended hours of work can lead to fatigue. While a strong work ethic should be highly valued, the consequences of working through extreme fatigue and a workplace culture that supports such behavior should be carefully examined. Although imposing mandatory off-duty hours does not guarantee that a worker will rest or sleep during that period of time, it does increase the likelihood” (Ergonomics, 1999, p. 1-5).

What nationally and/or internationally recognized procedures and/or technologies are used to evaluate a person's fitness-for-duty?

"Fitness-for-duty assessment involves the use of a screening test that an employee must pass before being admitted to a job function where safety or work quality may be critical. The objective of fitness-for-duty testing is to intervene and avoid impaired job performance" (Allen, Silverman, and Itkonen, 1992, p. 1). Objective screening tests should consider the worker's behavior and the skill required to perform given job functions. "In order for fitness-for-duty screening tests to be applied on a routine basis they must be sensitive to impairment of job skills that are related to safety, performance, and/or productivity. In terms of sensitivity, viable screening tests should have a performance measure that is sensitive to job performance impairment; and a detection or decision strategy that minimizes rejection of acceptable performance and maximizes rejection of unacceptable performance" (Allen, Stein, and Miller, 1990, p. 2).

Paul Gregorie, executive director of the Try and Save a Life (TASAL) project, reports that although there are over 60 tests to detect human impairment, most require over 30 minutes to complete. There are only two methods to detect impairment in 60 seconds or less (personal communication, June 18, 2001).

Dr. R. Leonard Goldberg, Assistant Medical Director of the Los Angeles City's Occupational Health and Safety Division, described the two types of tests that might be used to evaluate fatigue and impairment of field personnel. The first type of test evaluates physiological functioning. It is passive in that it does not require the subject to interact with the testing device. It is a visual-based testing system that assesses the ability of the eye to track a light and it also assesses the pupillary response to a sudden bright light stimulus. This type of test is designed to

replicate the eye testing that is done as part of the standard field sobriety test conducted by police officers. The second type of test evaluates cognitive and/or psychomotor functioning. It is interactive in that it requires the subject to respond to an auditory and/or visual stimulus by clicking a mouse or manipulating some type of pointing device (mouse, joy stick, dial) in response to an image displayed on a video display terminal (personal communication, June 7, 2001).

The two most practical devices currently available for use in a field setting are the SafetyScope Performance System distributed by Eye Dynamics, Incorporated and the Factor 1000 System, a Critical Tracking Task (CTT) system, distributed by System Tech, Incorporated. Both systems use computer-based algorithms to evaluate impairment, which eliminates the need to have a trained person interpret the test results. They each have testing modules that could be installed at fire stations. The tests are simple and require only 1-2 minutes per person to administer; however they each require base line testing to ensure accuracy (Goldberg, personal communication, June 7, 2001).

The SafetyScope examines a person's eyes to determine whether they are too impaired by drugs, alcohol, fatigue, or other factors to do their jobs safely. In a product press release, Chuck Phillips, CEO of Eye Dynamics, explains that "an employee looks into the SafetyScope and focuses on a beam of light. A video camera records the action, and software analyzes eye movement (smooth or jerky) and pupil dilation (small or large) and renders a verdict on whether there's any impairment" (2001, p. 2). Ron Waldorf, the SafetyScope's designer, reports that "the device is up to 97% accurate. Eight years of research, including government sponsored test studies of parolees and inmates, have brought back no more than a 3 percent positive rate" (Seyfer, 2001, p. 1).

"The CTT was conceived in the 1960's to test pilot and astronaut performance, and has a firm theoretical foundation in control theory. The CTT has been shown to be sensitive to alcohol and other drugs by a variety of investigators, and has had subsequent development as a device for screening alcohol impaired drivers (Allen, Silverman, and Itkonen, 1992, p. 2)."

Research over the past 30 years has developed the CTT capability, and has demonstrated the CTT sensitivity to a variety of impairments including alcohol, drugs, and fatigue. The test is similar to balancing a broomstick in the palm of your hand. As you try to keep the broom balanced, imagine that the broomstick is getting shorter and shorter until a person's reactions are not fast enough and he or she looses control. Because everyone's hand eye coordination is different; a person's reactions are much like a fingerprint, highly personalized in the same way that different people react differently to stress, fatigue, medications, and alcohol. Because this test measures a worker's ability against his or her own baseline it can more effectively predict if the worker may be vulnerable to accidents on any given day. In addition to measuring a worker's ability against his or her own baseline, daily use of the CTT helps increase worker safety awareness (Paul Gregorie, personal communication, June 18, 2001).

Al Kirby, Ph.D., senior scientist with Battelle Human Factors Transportation Center, expressed the opinion that the "gold standard" for evaluating fatigue is the psychomotor vigilance task (PVT) (personal communication, October 10, 2001). The PVT is a test of behavioral alertness invented by David F. Dinges, Ph.D., director of experimental psychiatry at the University of Pennsylvania School of Medicine and his associate John W. Powell, M. A., a research specialist at the University of Pennsylvania School of Medicine. It involves a simple portable reaction time (RT) test designed to evaluate one's ability to sustain attention and respond in a timely manner to salient signals. PVT performance has been demonstrated to be

highly sensitive to behavioral alertness associated with total sleep deprivation, cumulative partial sleep loss, and simulated night shift work. The PVT requires the subject to respond to a bright red light by pressing a button as soon as the light appears, which stops the counter and displays the RT in milliseconds for a 1-second period. The task duration is typically 10 minutes. Special software is used to extract multiple performance parameters from each PVT trail, which is able to detect vigilance decrement (David Dinges, personal communication, October 18, 2001).

What are the potential benefits and drawbacks of adopting and implementing procedures and/or technologies to evaluate a person's fitness-for-duty?

The TASAL project program literature reports that an estimated 10% of the workforce is impaired each day. Thus, the primary benefit of adopting a fitness-for-duty policy that contains specific evaluation procedures and performance criteria, which is supported by technology, is that it will protect the health and safety of both the public and the employees by preventing accidents. In addition, it provides the field supervisors with clear objective measures for determining impairment (Paul Gregorie, personal communication, June 18, 2001).

"Furthermore, individuals are not always able or willing to acknowledge that they are not fit for work. Many times an employee is not aware of the effects of stress, fatigue, illness, or drugs on his or her safety and performance. Performance testing can help identify a potentially hazardous situation before an incident develops" (Allen, Silverman, and Itkonen, 1992, p. 7).

One of the potential drawbacks of not developing policies and procedures that address fitness-for-duty is that restrictions on consecutive work hours could be imposed from an external source. Some public service industries are already regulated and others are seeking a legislative remedy to limit work hours and prohibit mandatory overtime.

"To ensure public safety, federal and state regulations prohibit motor carriers such as the Los Angeles County Metropolitan Transit Authority (MTA) from permitting their bus drivers to drive more than 10 hours, or for any period after having been on duty for 15 hours. Both of these hourly restrictions must be preceded by 8 consecutive hours off duty. On-duty time includes all driving and non-driving work for any employer. Federal and state regulations also direct motor carriers to require their bus drivers to record their duty status for each 24-hour period using driving logs" (Howle, 2001, p. 8).

The airline pilot unions have issued a joint demand for new rules that would establish one flight/duty time standard for all airline pilots, maintain the current 8-hour flight time limit, reduce the maximum scheduled duty time to 12 hours with restrictions for midnight to dawn flights, and give pilots a minimum break of 10 hours off-duty to an 8-hour sleep opportunity (Air Line Pilots Association [ALPA], 2001).

"New York State recently passed legislation regulating the work hours of residents and interns. The legislation limits residents to an 80-hour work week (averaged over four weeks) and limits them to 24 consecutive hours on duty" (McCallion and Fazackerley, 1991, p. 43).

"The Committee of Interns and Residents at Cambridge Hospital has joined the leaders of two other organizations and petitioned the Occupational Safety and Health Administration (OHSA) for a national limit on the hours medical residents and fellows spend at work. The petition would limit on-call shifts to every third night with a minimum of 10 hours between shifts and at least a 24-hour period off-duty each week. The measure would limit the total number of weekly hours on duty to no more than 80" (Lewis, 2001).

The California Nurses Association (CNA) has drafted legislation that would ban mandatory shifts, saying the practice leads to fatigue, which increases the potential for errors and oversights, which could affect patient care (Ornstein, 2001).

What factors prevent the LAFD from implementing procedures and/or technologies to evaluate an employee's fitness-for-duty?

"The diverse, complex, and profound implications of shift work have been only relatively recently acknowledged. The need for better strategies in shift-work design and management of this complex biopsychosocial phenomenon is increasingly appreciated. Intervention strategies for promoting healthy shift work has begun in four major areas: work schedule design; napping; natural biological therapies; and drugs. Workers' education on sleep hygiene, stress management, physical activity, ambient temperature, nutrition, and individual behaviors are also of recent research interest" (Hossain and Shapiro, 1999, p. 293-295).

"Although more calls and less sleep can pose major public safety dilemmas for EMS systems, other reasons contribute to consideration of alternative shift schedules. Tight budgets can impact the decision to add more staff and/or more ambulances to manage an increase in workload" (Benson, 1993, p. 29). Paley and Tepas (1994) reported that one of major obstacles in introducing an alternative shift schedule to firefighters "was to challenge singular notions of fatigue. The historical perspective views fatigue largely as a product of physical activity and an experience that is highly correlated with time on task. However, the simple view of fatigue cannot explain the presence of significant Type of Shift X Time at Work interaction for both sleepiness and mood ratings. These interactions would suggest that in addition to time-at-work variables, fatigue is also affected by time-of-day" (p. 282).

Studies of 12- versus 24-hour shifts for firefighters, EMTs, and flight nurses present results, which question whether the on-call nature of emergency service work fits the conclusions drawn from the study of other more traditional shift workers. A retrospective study of EMTs working in a free-standing public EMS system reported that "changing work schedules from 24- to 12-hour shifts appears to be associated with greater satisfaction with their work schedule, reduced schedule-related social/family disruptions, and decreased levels of emotional exhaustion and feelings of burnout. However, it was associated with little or no changes in global job satisfaction, global job stress, cynical attitudes toward patients, and feelings of personal accomplishment. This implies that schedule modifications [alone] are no panacea" (Boudreaux, Mandry, Brantley & Jeffries, 1997, p. 86-87).

A prospective study comparing the performance of flight nurses on a series of neuropsychologic tests following 12- and 24-hour shifts demonstrated that "performance was not predicted by shift length, time of day (day versus night), amount or quality of sleep before or during shift, or [subjective] fatigue ratings. Uninterrupted sleep, stress ratings, and number of flights per shift modestly reduced some test scores. Twenty-four hour shifts per se do not result in cognitive impairment compared with 12-hour shifts. Inconsistent sleep, number of flights, and the stressfulness of flights may have greater impact" (Manacci et al., 1999, p. 20).

The debate over 24-hour shifts seems to depend upon the personal experience of the author. Gregory Lathrop (1997), director of Mission Air Medical Ambulance in the mountains of North Carolina, contends that "given our mission profile of 600 flight hours per year and a ground transport volume of only 50 missions per year, 24-hour shifts have proven to be an effective tool with regard to the overall operation of our transport program." However, he cautions that "if you average 23 of 24 hours each day in the air or on the road, reconsider the 24-

hour option. The 24-hour shift option should be considered by programs with low flight volumes and few, if any, ancillary duties" (p. 8-10). David Thompson, M. D. (1997), medical director of EastCare in North Carolina, argues that "it is a bad idea to institutionalize any schedule that promotes money over safety or productivity over patient care. Twenty-four hour shifts are popular because of the financial benefits, both to medical crewmembers and employers. The negatives exist in terms of patient care" (p. 11-12).

When Livermore Fire Department changed the work schedule for their battalion chiefs from the traditional 56-hour platoon-duty workweek, "it took leadership and cooperation by all staff to facilitate the change from the traditional work day to a more efficient execution of administrative and operational duties. To facilitate the drastic change to the five-day schedule, battalion chiefs were given a title change to division chief and a monetary incentive" (Bramell, 1997, p. 20). The work schedule for the division chiefs has continued to evolve with their input and motivation was a major factor in stimulating these mid-managers to work a diverse schedule (p. 21). Finding the incentives that would motivate line personnel could prove to be a major obstacle.

What procedures and/or technologies are other fire service agencies using to evaluate the fitness-for-duty of line personnel working multiple shifts?

"Fatigue has often been viewed as a simple variable that is highly and positively correlated with time on task in the work place. Within this historical perspective, physiological fatigue is a condition produced mainly by physical activity. The hours of service regulations, used to regulate commercial transportation system operators, are a good example of this perspective and highlight the shortcoming of this view" (Paley and Tepas, 1994, p. 269). In keeping with the contemporary research that has demonstrated time-of-day variation in

performance associated with circadian rhythms, the limited research involving firefighters and EMTs has focused on alternative shift schedules. Benson (1993) reports that in Austin, Texas, 24-hour shifts stopped making sense when workers were averaging 18 calls in 24 hours. Rising call volume has led other EMS directors to become concerned about chronic fatigue among emergency crews but there is no data to show that it's a problem (p. 28).

"Schedules need to take into account the burnout factor which is accelerated by busier shifts" (Benson, 1993, p. 29). The North American EMS Employee Organization Network (NEEON), a research-gathering group of EMS unions, asserts that unit/hour utilization (UHU) is a meaningful measure of ambulance activity. It can be determined by dividing the number of calls done annually in an EMS system by the number of hours in a year, multiplied by the number of 24-hour ambulances. Anything over 0.50 UHU is considered excessive because it leads to worker fatigue and burnout within five years, with attendant ramifications for attendance, job performance, patient care, and system liability (Saly, 1999, p. 28).

The manufacturing industry has typically use a weekly counterclockwise shift rotation, but circadian research has demonstrated that this type of shift change is disruptive to family and social life, that the weekly change prevents workers from adapting to any shift, and results in chronic sleep deprivation and fatigue. Paley and Tepas (1994) found that firefighters working a traditional counterclockwise 2-week rotating shift schedule of three 8-hour work periods never adapted to the work schedule. The authors determined that the effects of traditional shift-work on firefighters were similar to those in studies of industrial shift-workers (p. 283).

"To devise a rational method for shift scheduling and to mitigate the deleterious effects of shift-work, it is necessary to understand the basic nature of circadian rhythms and sleep" (Whitehead, Thomas, and Slapper, 1992, p. 113). The authors found that best strategy is to work

the same shift and keep the same sleep pattern, however compromise strategies may include anchor sleep, split sleep periods, and napping to mitigate circadian disruption. When working a rotating shift schedule, it is better to observe a monthly clockwise rotation, which produces less circadian disruption (p. 117-118).

Outside of the marketing materials provided by the manufacturers there is very little discussion of field applicable tools and/or methods for evaluating fatigue. “The scarcity of systematic and quantitative attempts to manage fatigue may reflect the lack of simple, yet functional, tools available for use in the workplace. Such tools may not currently be in high use because it is difficult to generalize the results of laboratory-based studies to a work environment. Experimental studies typically oversimplify the complex psychosocial context in which shift-work occurs. These studies frequently preclude many of the typical social activities that compete with rest and recovery. Similarly, relatively few shift schedules have been exhaustively modeled in experimental settings. Given the lack of consistent findings for specific shift schedules, it can be difficult for organizations or individuals to risk extrapolating specific findings to different shift schedules” (Dawson and Fletcher, 2001, p. 145).

PROCEDURES

This research project employed the evaluative research methodology using materials from the National Emergency Training Center (NETC) Learning Resource Center, Internet, and Los Angeles County Health Management Library. A review of the literature on fatigue, shift-work, and fitness-for-duty was conducted for the purpose of identifying the factors that may affect personnel working twenty-four hour shifts. A questionnaire regarding fitness-for-duty/work restriction policies and procedures (Appendix B) was distributed via e-mail, in person, or by telephone to all fire-based EMS providers in Los Angeles County. A matrix showing the

results of the survey is presented in Appendix C. Two computer-based technologies, which have been developed to evaluate fitness-for-duty, were evaluated using product demonstrations, supporting literature from the manufacturers, and interviews with scientists currently working in the field of fatigue evaluation. Finally, an evaluation of the financial implications of implementing or not implementing a fitness-for-duty evaluation protocol and program was conducted.

Definition of Terms

Accident: Something unintentional occurred that was not due to such causes as illness, suicide, war, terrorism, or criminal activity.

Advanced Life Support (ALS): Procedures and techniques used by EMT-P personnel to stabilize critically sick and injured patients who exceed Basic Life Support procedures.

Basic Life Support (BLS): Basic non-invasive first-aid procedures used by EMT and First-Responder personnel to stabilize critically sick and injured patients.

Circadian rhythm: From a Latin phrase meaning “about a day.” The endogenous biological rhythm of rest/activity and body temperature cycle over a 24-hour period.

Deep sleep: Sleep stages 3 and 4, during which the body begins to rejuvenate itself. People awakened during these stages are usually very sluggish and slow to react for up to half an hour.

Emergency Medical Technician I (EMT-I): An individual trained in Basic Life Support according to the standards prescribed by the local, regional, or state EMS agency.

Emergency Medical Technician Paramedic (EMT-P): An EMT who has received additional training in Advanced Life Support above that of an EMT-I as allowed by applicable state and local laws.

Fatigue: A state of being tired. It can be caused by long hours of work, long hours of physical or mental activity, inadequate rest, excessive stress, or a combination of these factors.

Light sleep: Sleep stages 1 and 2, during which people are easily awakened and can recover from sleep fairly quickly.

Microsleep: A very brief period of sleep lasting a few seconds to a few minutes, characterized eyelid drooping, head drooping, and loss of consciousness. EEG recordings show the presence of sleep spindles.

Nap: Sleep shorter than the habitual nocturnal sleep period.

Rapid eye movement (REM) sleep: Normally occurs during the latter one-third of the sleep cycle and is essential in getting a restorative night's sleep.

Restorative sleep: Requires a series of approximately 90-minute cycles (stages 1, 2, 3, 4, and REM), repeated four to five times during a sleep session.

Shift-work: A work schedule where at least 50% of work is required to be done outside of normal daylight hours (8 a.m. to 5 p.m.).

Sleep deprivation: No sleep for at least 24 hours (total) or anything short of the "usual" amount of sleep (partial). Usual varies from person to person.

Sleep inertia: The five to thirty-minute period of sluggishness after awakening.

Sleepiness: A drive to sleep resulting from neurobiological processes relating to circadian rhythms.

Sleep management: The use of scientific techniques for optimizing sleep for those who must work under demanding shift-work schedules or continuous work episodes.

Slow wave sleep (SWS): Normally most pronounced in the first portion of the night.

Vigilance: The ability to notice what is going on in our surroundings.

RESULTS

There were several factors, which limited this applied research project. First, very few studies of fatigue related to work-fitness have been conducted using firefighters and/or paramedics as subjects. Second, few of the fire departments responding to the survey employed any protocol or methodology other than limitations on consecutive hours worked to determine fitness-for-duty of line personnel. Third, the technologies currently available for use in evaluating fitness-for-duty is not in widespread use by any industry, so there are only a limited number of actual case studies about the effectiveness and/or benefits of the programs to help justify the expense. Although it was possible to estimate some of the costs associated with implementing a program there was no way to estimate the cost of failure. Data on fatigue-related mistakes was not available and therefore was not included in the analysis of the problem.

Answers to Research Questions

Research Question 1. What nationally and/or internationally recognized procedures and/or technologies are used to evaluate a person's fitness-for-duty? The author found that there are two basic types of technology solutions that could be practically applied to fitness-for-duty evaluations. The first is a passive technology type device, which uses a video eye-scan linked to a computer algorithm to determine whether a subject is impaired. The second uses interactive technology, which requires the subject to perform a hand-eye coordination exercise utilizing a pointing device (mouse, dial, or joy stick) and video display. A computerized algorithm compares the subject's performance with a previously established base line to determine fitness or impairment.

Toquam and Bittner (1996) reported on two studies, which evaluated the sensitivity of fitness-for-duty technologies to the presence of alcohol. The report concluded that one of the

tests looked especially promising as a fitness-for-duty assessment tool. However, during a follow-up interview with Dr. Bittner, he expressed the opinion that the technologies evaluated during the study were not practical for field use because of the problems associated with an unacceptably high rate of false positives and false negatives. He suggested that a more practical approach might be to place the members in a dark room seated in comfortable chairs and instructing them to tilt their heads back. Anyone that falls asleep in 5 minutes or less is probably too tired to work. (personal communication, September 17, 2001).

John Hanley, M.D., professor emeritus at the UCLA Neuropsychiatric Institute and former flight surgeon with the National Aeronautics and Space Administration (NASA), recommended using a simple task based performance evaluation to determine impairment. He suggested that the members be required to perform some task that they would normally perform as part of their regular emergency duties. If they cannot perform the task according to the established standard, they should be declared unfit for duty. The specific task examples discussed were reading and identifying EGK rhythms for paramedics and donning self contained breathing apparatus for firefighters, however other work related tasks could also be used (personal communication, September 10, 2001).

The National Highway Traffic Safety Administration (NHTSA) (2001), in collaboration with the National Center on Sleep Disorders Research (NCSDR), has developed an education program to increase shift-workers' awareness of the dangers of drowsy driving, help them improve to improve the quality of their sleep and reduce sleepiness, and ultimately, reduce the incidence of drowsy driving. While the program is not technically an evaluation tool, it contains scientific background material on the issues of fatigue and sleepiness along with guides and brochures for the employer, employee, and the families of shift-workers. It also includes a

PowerPoint program, video, and workplace posters. The materials were developed by a panel of experts and could be incorporated into an overall fatigue management program.

Circadian Technologies, Inc. (CTI) is a source of scientific information and materials that could be used in the developing work schedules and fatigue management programs. The company specializes in projects designed to improve productivity, achieve cost savings, and maximize the performance, safety and quality of life of the 24/7 workforce. They specialize in developing innovative work schedules, training, and workforce optimization tools that address the special challenges of working around the clock in industrial, transportation, and other 24/7 businesses. They recommend providing orientation and/or periodic training covering circadian rhythms and coping strategies for shift-work along with access to lifestyle programs aimed at improving diet and regular exercise (CTI, 2001).

The United States Coast Guard (USCG) has developed a crew endurance management (CEM) program for deep draft vessels. “The CEM practices proposed in the guide compile field-tested methods to manage the risk factors that affect crewmembers’ health and performance. The CEM principles refer to the concept of endurance management, rather than sleep or fatigue management, because in maritime environments a variety of stressors, not solely sleep loss, have a direct impact on crew performance” (Comperatore and Kirby, 2001, p. iii).

Research Question 2. What are the potential benefits and drawbacks of adopting and implementing procedures and/or technologies to evaluate a person’s fitness-for-duty? The author found that the primary benefit to agencies that have adopted a fitness-for-duty evaluation program is that it could reduce accidents and injuries by preventing impaired people from working. A secondary benefit was that it would encourage people to come to work rested and ready to work. One case study reported that the Factor 1000 proved useful in identifying at-risk

employees, which allowed management to address problems through Employee Assistance Programs rather than the disciplinary process (Paul Gregorie, personal communication, June 18, 2001).

The primary drawback of implementing a fitness-for-duty program, whether or not it is supported by technology, is the cost of the program. The direct costs, which should include training the supervisors and the workforce, could be easily calculated. These direct costs could be substantial depending on the testing protocol and whether or not it includes purchasing or leasing some type of technology. In the case of the SafetyScope, if all on-duty field members were tested daily at a cost of one dollar per scan, the priced quoted by the manufacturer, the total annual cost for just that portion of the program would exceed $350,000.

The indirect and hidden costs are more difficult to calculate. It is possible that additional staffing would be required to fill daily vacancies currently filled through the overtime hiring procedures. There is no experimental data which could be used to accurately predict the costs associated with conducting secondary examinations for members determined to be impaired by the initial examination naps and/or providing transportation for members determined to be impaired. Other less tangible but associated costs could include closing resources, paying for naps, and the staff time required to handle the inevitable grievances.

However, safety experts suggest that the indirect financial cost of accidents and injuries are 3 to 10 times the actual cost of the injury itself, so the savings in the workers compensation area could offset the actual cost of the program. One case study reported a savings of $95,000 per year after introducing the Factor 1000 (Paul Gregorie, personal communication, June 18, 2001).

Research Question 3. What factors would prevent the LAFD from implementing procedures and/or technologies to evaluate an employee's fitness-for-duty? The major obstacle preventing the LAFD from implementing a fitness-for-duty policy is the requirement to meet and confer over any proposed change in work rules. As a general rule, firefighters are constrained by tradition and any change in work schedule, such as limiting consecutive work hours or using some type of fatigue evaluation to determine eligibility for overtime, could present an obstacle in terms of acceptance by the workforce.

The collective bargaining process required to develop a fitness-for-duty policy would undoubtedly require reopening the employment contract because of the potential impact the policy would have on overtime and the due process procedures that would be required to enforce the policy. Some of the issues that may need to be addressed during negotiations could include the following questions. What is the operational definition of fit-for-duty? What type of test will be used to evaluate employees fitness-for-duty? When will the evaluation be performed? Who will perform the evaluation? What training will the employees and the evaluators receive? What will happen to an employee that is determined to be impaired? Will they be sent home? If so, should they be allowed to drive? If not, what are their options for alternate transportation? If a cost is incurred by using alternate transportation, who will pay? If they are not allowed to leave, will they be allowed/required to take a nap? If so, what should be the minimum and/or maximum time allowed/required? Should the employee be revaluated after waking from the nap? If so, at what point since some studies have shown that sleep inertia may mask the value of the nap? Should the employee be compensated for the nap? If so, how many hours? Do those hours count towards cumulative hours under the Fair Labor Standards Act (FLSA)? Should the employee be required/allowed to undergo a secondary evaluation by a medical professional? If so, who will be

responsible for the expenses? Will the employee be compensated for the time required to complete the secondary evaluation process? If the secondary exam has the ability to determine that the cause of impairment is anything other than fatigue, what due process rights will be afforded to the employee? If the employee is determine not to be impaired by the secondary exam, who will be responsible for the expenses? Will there be any form of discipline that results from the findings of the secondary evaluation? If the employee is a licensed paramedic and the cause of impairment is other than fatigue, under what conditions will the State EMS Authority be notified? What type of fatigue management training program should be provided to the employees? Are statistical data available that show emergency hours worked by time of day, day of week, and month or season for each individual company at each work location? Will duty schedules be adjusted for individual companies and/or work sites to take into account the cumulative effects of sleep disruption and sleep deprivation? Will consecutive work hours be evaluated differently at different work locations? If so, how will that affect overtime hiring? Will the hiring policies be different for voluntary versus mandatory overtime? Will naps be allowed outside of normal sleep hours? Will the work environment be modified to provide quite, comfortable areas for napping?

While these questions are only a partial sample of the types of issues that may need to be addressed through the collective bargaining process, both labor and management should keep in mind their responsibility to the employees and the community.

Research Question 4. What procedures and/or technologies are other fire service agencies using to evaluate the fitness-for-duty of line personnel working multiple shifts? The author found that the majority of fire departments in Los Angeles County have addressed the issue of fitness-for-duty through limitations on consecutive hours worked in policies that have been negotiated

through the collective bargaining process. Only two of the responding agencies actually had a prescribed methodology for determining fitness-for-duty. The other agencies left the actual evaluation of fitness-for-duty up to the discretion of the first or second line supervisor with virtually no evaluation protocol, criteria, or guidelines on how to evaluate and document fatigue.

DISCUSSION

Relationships between study results and findings of others.

Although there is an extensive body of literature on sleep deprivation, fatigue, and shift-work, there were no clear-cut answers. The study identified that there is no simple effective method for evaluating the fitness-for-duty of line personnel. It was discovered that most of the Los Angeles area fire departments had policies that placed limitations on the number of consecutive hours worked by line personnel. However, only two of the responding agencies had any specific methods or guidelines to be used in evaluating fitness-for-duty. One agency had a specific fit-for-duty policy, the other had adopted the protocol contained within in their drug and alcohol policy to evaluate and document fatigue.

Given that stress and fatigue are the inevitable by-products of emergency service work, there are strategies that can be adopted by individuals and organizations to minimize the degrading effects of stress. “Certainly one of the most effective of these is planning, anticipating and rehearsing actions to be taken under stress – either expected actions or those required by emergencies. Research has shown that, if individuals can predict, understand, and have knowledge of and a sense of control over the stressor, then they are more likely to develop successful coping strategies” (Huey and Wickens, 1993, p. 109).

Organizational implications of results.

It has been well documented that the effect of lost sleep accumulates over time and does not dissipate, however the implications of this fact for 24-hour operations have not been well studied (Dement, 1997, p. 783). Given the 24-hour nature of emergency services provided by the LAFD, it is essential that field supervisors be provided with policies, procedures, performance criteria, and training on evaluating a member's fitness-for-duty.

As a public service agency, the LAFD is charged with protecting the public health and safety. One essential component of public safety is the daily deployment of a safe and effective work force. This includes supporting that workforce with duty schedules that take into account service demands and workload during the work shift. The fact that studies have been able to equate the impairment caused by fatigue with the impairment cause by alcohol should put both labor and management on notice that existing work rules need to be reevaluated. The conditions that cause fatigue are well documented. Sleep disruption, sleep deprivation, extended hours, and prolonged wakefulness are all potential consequences of the current 24-hour shift schedule and should be taken into consideration when developing daily duty schedules and when scheduling personnel for multiple consecutive 24-hour shifts.

Another factor that warrants attention is the make up of crews and teams. Huey and Wickens (1993) suggest that "effective teams have a combination of high loyalty, morale, commitment, adaptability, and exchange and coordinate information. Team qualities which may provide a buffer against organizational and environmental stress include: effective leadership, appropriate selection of members, commitment and cohesion, open climate, giving and accepting constructive criticism, individual initiative, high creativity, positive intergroup relations, and role clarity" (p. 112).

The continuity of teams was the issue that brought the fatigue and fitness-for-duty issues to the attention of the EMS Commission. Paramedics and EMTs both felt that the make-up of ALS teams played an essential role in fielding a safe and effective work force. In a high volume EMS system like Los Angeles, skill levels, training, and experience should be considered in the assignment of personnel and workload should be considered in determining the duration of an assignment.

RECOMMENDATIONS

The research shows that work schedules and consecutive hours-worked are major components of stress and fatigue in the workplace and that stress and fatigue lead to mistakes. Therefore, daily duty schedules, overtime policies, and fitness-for-duty evaluation methods must ensure the health and safety of both the public and the workforce.

Recommendation 1. The LAFD should begin collecting and analyzing complaint and mistake data in terms of hour-of-day, day-of-week, month, season, workload, and consecutive hours worked.

Recommendation 2. The LAFD should work with the labor organizations to develop daily duty schedules that take into account the effects of sleep disruption and sleep deprivation by implementing counter measures that effectively combat the short-term and long-range impact of fatigue.

Recommendation 3. Work with the labor organizations to develop overtime policies and fitness-for-duty evaluation methods that ensure the health and safety of both the public and the workforce.

Recommendation 4. The LAFD should work with the labor organizations to develop work policies and environments that to take into account the importance of regular restorative sleep when unusual duty hours are required.

Recommendation 5. The LAFD should work with the labor organizations to develop a training and management plan that integrates sleep hygiene, nutrition, motivation, and operational requirements into a Crew Endurance Management (CEM) system.

Recommendation 6. The LAFD should seek funding to conduct a systematic study on the rational design and evaluation of polyphasic sleep/wake patterns as potential solutions to sleep management under prolonged work requirements.

Recommendation 7. The LAFD should seek funding to conduct a trial study of the technologies currently available to evaluate fitness-for-duty using firefighters and paramedics as subjects.

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APPENDIX A

DEPARTMENT OF HEALTH SERVICES **Discussion Document**
COUNTY OF LOS ANGELES 1-17-01

SUBJECT: **CONSECUTIVE WORK HOURS FOR EMT-1S AND PARAMEDICS**

PURPOSE**:** To minimize impaired judgment or motor skills of prehospital personnel that may be attributed to fatigue or sleep deprivation by limiting the number of consecutive hours an EMT-1 or paramedic may work on a Basic (BLS) or Advance Life Support (ALS) Unit.

PRINCIPLES:

1. Fatigue may produce performance deficits such as increased reaction time. Increased treatment errors, and increased risk of vehicular accidents.

2. Negative job performance may be the result of EMT-ls and paramedics who become fatigued because of excessive call volume or extended work hours without adequate rest periods.

3. Since hours of work can be controlled, professional organizations and regulatory agencies should ensure that pressure for efficiency does not result in fatigue and the consequent compromise of both the patient and field personnel.

I. Number of Consecutive Hours Worked

A. With the exception of extreme emergencies, BLS and ALS personnel may not be required to work in excess of 48 consecutive hours as first responding EMT-ls or paramedics or transporting EMT-1s, or paramedics during any 72-hour period.

B. BLS and ALS personnel may voluntarily work up to 72 hours.

C. Providers shall utilize reasonable work schedules, work periods and provide adequate working conditions necessary to maintain safety and provide adequate patient care.

D. Provider shall not schedule or allow an employee to respond to 9-1-1 calls who is impaired by excessive fatigue, illness, injury, or other factors, which may reasonably be anticipated to constitute a threat to the health and safety of patients or the public.

E. Provider shall provide each EMT-1 and paramedic an amount of time off, immediately following each work period, which equals no less than twenty-four (24) HOURS.

II. Rest Periods

ALS personnel are required to have at least three hours of uninterrupted rest during a 24-hour work period.

APPENDIX B

Fitness-for-duty Questionnaire

The Los Angeles Area Fire-Based EMS Providers in cooperation with the Los Angeles County EMS Agency are conducting a survey of fire-based EMS providers throughout California as part of our research on "Fitness-for-duty." We are interested to know how your department addresses fitness-for-duty of line personnel either in terms of limitations on consecutive hours worked or specific guidelines to field supervisors specifying how fitness-for-duty is to be assessed and evaluated. Your responses, without specific agency identifiers, will become part of the report submitted by the Fitness-for-duty Task Force to the Los Angeles County EMS Commission.

Agency Name: _____ Date completed: _____
Name of person completing the questionnaire: _____
Rank/Title: _____ Phone number: _____

1. What is your department's normal shift schedule? On _____ Off _____ Cycle _____

2. Does your department have a policy which limits the number of consecutive hours that may be worked by line personnel? No _____ Yes _____ If yes, what are the maximum number of consecutive hours that are permitted by the policy? Voluntary _____ Mandatory _____

3. What is the minimum numbers of hours that must be taken off, after the maximum number of hours have been worked? _____

4. Does your policy provide any specific guidelines and/or technology that give specific instructions to field supervisors on how to assess and evaluate fatigue and/or fitness-for-duty? No _____ Yes _____ If yes, please describe your evaluation procedure or attach a copy of your policy.
   _____
   _____
   _____
   _____
   _____
   _____

5. Are all field officers trained to perform the fitness-for-duty evaluation procedure contained within your policy? No _____ Yes _____

6. Does your policy contain procedures or guidelines on what to do with a member that that is determined to be unfit-for-duty? No _____ Yes _____ If yes, please describe the procedure or attach a copy of your policy. _____
   _____
   _____
   _____
   _____

APPENDIX C

Fitness-for-Duty Survey Results
Los Angeles County Fire Departments

Departments Surveyed	28
Departments Reporting	27
Departments with Policies Limiting Consecutive Work Hours	17
Range (hours)	48 - 240
Departments with Off-Duty Requirements Following Maximum Hours Worked	15
Range (hours)	8 - 24
Departments with Fit-for-Duty Guide Lines	2
Departments that Provide Fit-for-Duty Evaluation Training	2
Departments with Unfit-for-Duty Procedures	2