



Fire Fighter/Emergency Medical Technician Dies During the Night at Fire Station – Arizona

SUMMARY

On June 23, 2005, a 33-year-old career female Fire Fighter/Emergency Medical Technician (FF/EMT) reported to her duty station. During the daylight portion of her shift, she responded to two calls: a lightning strike on a house and a fire apparatus breakdown. After dinner, she retired to her bunkroom. Early the next morning, at 0205 hours, her crew (Rescue 121) and Brush 121 were dispatched to a medical call, but she did not respond. A crew member checked on her and found her unresponsive. After calling the brush crew back to the station, the crew member assessed her and radioed Dispatch, who dispatched a neighboring fire department (FD). Cardiopulmonary resuscitation (CPR) and advanced life support (ALS) treatment were performed by crew members until paramedics from the neighboring FD arrived. From the FF/ EMT's clinical condition it was obvious she had expired much earlier in the night. The attending emergency department (ED) physician from the local hospital gave permission for the paramedic to pronounce the FF/EMT dead. The death certificate, completed by the Medical Examiner, and the autopsy, completed by the Forensic Pathologist, listed "oxycodone intoxication" as the cause of death with "mild thickening of the mitral valve" and "mild diffuse nephrosclerosis" as other conditions.

NIOSH investigators offer the following recommendations to address general safety and health issues although they probably would not have prevented this death:

*Provide pre-placement and annual medical evaluations to **ALL** fire fighters to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.*

Ensure fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting.

INTRODUCTION & METHODS

On June 23, 2005, a 33-year-old female FF/EMT died sometime during the night after retiring to her bunkroom. Despite CPR and ALS performed by crew members, the FF/EMT died. NIOSH was notified of this fatality on June 28, 2005, by the United States Fire Administration. NIOSH contacted the affected FD on July 7, 2005, to obtain further information and to initiate the investigation. On July 20, 2005, a Safety and Occupational Health Specialist and an Association of Teachers of Preventive Medicine (ATPM) intern from the NIOSH Fire Fighter Fatality Investigation Team traveled to Arizona to conduct an on-site investigation.

During the investigation NIOSH personnel met and/or interviewed the following persons:

- Fire Chief
- Crew members
- FF's husband

NIOSH personnel reviewed the following documents:

- FD incident report
- FD training records
- FD annual response report for 2004
- FD standard operating guidelines

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at

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- Ambulance report
- Death certificate
- Autopsy report
- Primary care physician records

INVESTIGATIVE RESULTS

On June 23, 2005, the FF/EMT arrived at her fire station at 0600 hours. She was scheduled for an annual FD medical evaluation that morning. She left the station, drove to the clinic, and completed the physical evaluation. She had a normal resting electrocardiogram (EKG) and performed an exercise stress test (EST), exercising for 10 minutes, 53 seconds using the Bruce protocol,¹ achieving a work level of 13.5 metabolic equivalents (METS) and a maximum heart rate of 134 beats per minute (72% of the maximal age-predicted heart rate). Her resting blood pressure was 97/69 millimeters of mercury (mmHg); it rose to 128/74 mmHg during exercise. Her heart rate and blood pressure responses to exertion were appropriate. No chest pain and no ischemic changes were found on the EKG; no arrhythmias were identified; and the EST was deemed negative. A drug screen was also negative, and the FF/EMT was cleared for duty.

She returned to her station at 1000 hours. The FD was participating in “Safety Stand Down Day” and this FF/EMT participated in discussions of various safety topics including physical fitness. At 1225 hours, the FD was dispatched to a residence that had been struck by lightning. The FF/EMT donned her bunker gear and responded on the engine. Arriving on scene, it was determined to be a false alarm. At about 1300 hours, the crew returned to the station and the FF/EMT’s husband brought her dinner. At 1630 hours, Rescue 121 was dispatched with other FD units to assist with a FD engine that had broken down at an intersection. The FF/EMT, riding R121, assisted with directing traffic while the engine was removed from the intersection, and she assisted with removing equipment and loading it onto Brush Truck 121. During this time, crew members noticed the FF/EMT’s neck was red. When crew members informed her of

this, she commented that the new vitamins she was taking were making her itch.

At about 1700 hours, there was a departmental meeting to discuss backfill coverage during wildland fire assignments. During this meeting, the FF/EMT spoke with several FD personnel and was not exhibiting symptoms other than her eyes appearing irritated. Again, she commented that the new vitamins were causing the problem. At about 1830 hours, the FF/EMT ate dinner and went upstairs to her bunkroom. Passing a crew member in the hallway, the FF/EMT commented that she was tired and going to bed. The shift Captain went to her room to advise her about a meeting the next morning and subsequently inquired about her rash; she stated that it seemed to be going away. At about 1930 hours, the FF/EMT’s husband arrived at the station to visit her. At about 1945 hours, her daughter called and spoke with the FF/EMT on the telephone. Her husband left the station at about 2020 hours. Both the daughter and husband reported that the FF/EMT showed no signs and expressed no concerns about health problems.

On June 24, 2005, at 0205 hours, the FD was dispatched to a medical call. As Brush 121 began to respond, a crew member asked the Captain if the FF/EMT was a heavy sleeper. The Captain said “yes” and sent him upstairs to awaken her while Brush 121 continued to respond.

The crew member knocked on the bunkroom door several times. Not getting a response, he then entered the room and found the FF/EMT lying on the bed, face down with her head and right arm hanging off the bed. She did not respond to verbal or painful stimuli. The crew member placed her on her back, opened her airway and checked for a pulse. Finding no pulse, he ran to the Rescue unit and obtained medical equipment. He placed an oropharyngeal airway and attached a cardiac monitor to her. The monitor revealed asystole (no heart beat) and he began rescue breathing with a bag-valve-mask. The crew member notified Brush 121 of the situation via radio at about 0209 hours and Brush 121 returned to the station.



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Upon Brush 121's arrival at the station, resuscitation efforts including CPR had already been initiated by the crew member. The Captain notified Dispatch at about 0211 hours and requested an ambulance from a neighboring FD. During the resuscitation, emesis developed in the bag-valve-mask, and suctioning was performed. An intravenous line was placed and the incident was reported to the local hospital ED. From the FF/EMT's clinical condition it was obvious she had expired much earlier in the night. After receiving the patient report from the paramedic, the attending ED physician gave permission for the paramedic to pronounce the FF/EMT dead at 0232 hours, and resuscitation efforts were stopped. The sheriff's office and coroner were then notified.

Medical Findings. The death certificate, completed by the Medical Examiner, and the autopsy, performed by the Forensic Pathologist on June 25, 2005, included the following findings:

- Oxycodone intoxication (blood level of 0.85 milligrams per liter [mg/L])(therapeutic blood levels are less than 0.1 mg/L)²
- Mild thickening of the mitral valve

Microscopic examination of the heart revealed scattered foci of interstitial fibrosis.

Primary care physician (PCP) medical evaluations from 2000 revealed two coronary artery disease (CAD) risk factors: family history of CAD and hyperlipidemia successfully treated with a low cholesterol/low fat diet and an exercise program.

During 2004 the FF/EMT reported 10-12 episodes of erratic behavior, mood swings, and paranoia. Her local primary care provider referred her to a tertiary care medical center for an extensive medical evaluation. Over a 2-3 month period she was evaluated for the following conditions:

- 1) Possible seizure disorder. Work-up included a magnetic resonance imaging (MRI), blood tests, and a neurology consultation. These

tests were essentially normal, and a detailed description of the episodes effectively ruled out the possibility of seizures.

- 2) Possible hypoglycemic disorders. Work-up included several specialized blood tests (insulin, c-peptide, beta hydroxybutyrate, cortrosyn stimulation) and an endocrinology consultation. These tests were all normal and her unusual symptoms were not felt to be related to a hypoglycemic condition.
- 3) Possible arrhythmia or heart problem. Work-up included blood tests, a Holter monitor, resting electrocardiogram (EKG), and an exercise stress test done as part of her FD medical evaluation. These were all normal.
- 4) Possible psychiatric condition. Work-up included a consultation with a psychiatrist who diagnosed probable post-traumatic stress disorder due to an assault during her teens. The diagnosis of a mood disorder (not otherwise specified) or a mild bipolar disorder was also considered. She had been prescribed two anti-depressants and a diuretic by her PCP prior to this episode.

According to the FF/EMT's husband, who had spoken to her about six times throughout the day and was the last person to see her prior to her death, she did not express any symptoms of cardiac-related problems. She did not seem depressed or mention suicidal thoughts. Her only complaint was that she was tired. He was unaware that she was taking a new vitamin.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this combination FD consisted of 35 uniformed personnel, served a year-round population of 15,000 in a 25 square mile area, and had two fire stations.



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In 2004, the FD responded to 3,163 calls: 197 fires, 166 accidents, six technical rope rescues, 158 false alarms, 766 community relations calls, 530 citizen assist calls, and 1,340 emergency medical calls.

Membership, Employment, and Training. The FD requires all “redshirt” volunteer fire fighter applicants to complete an application, be at least 18 years of age, possess a high school diploma or equivalent, possess a valid state driver’s license, pass a physical examination, and have the ability and willingness to train in fire fighting and related activities.

To become employed as a “reserve fire fighter,” the FD attempts to hire from qualified “redshirts.” Qualifications and testing for reserves follow the same guidelines as full-time personnel, which includes certifications as Fire Fighter II (FFII) or Emergency Medical Technician. The applicant may achieve the certification within one year of hire at the discretion of the Fire Chief. The applicant must pass a written exam, a physical examination, and a physical agility test (PAT) prior to being hired. Full-time fire fighters are hired from in-house reserve fire fighters if possible. Full-time fire fighters work 24 hours on-duty, 0800 hours to 0800 hours, and are off-duty for 48 hours.

Physical Fitness Testing. All fire suppression personnel are required to pass the following physical fitness tests:

1. 1st Quarter: Wildland Physical Fitness Test (Work Capacity Test [Pack Test]) Personnel will wear a 45-pound pack and walk 3 miles within 46 minutes
2. 2nd Quarter: Modified Work Capacity Test Personnel will wear a 25-pound pack and walk 3 miles within 46 minutes
3. 3rd Quarter: Physical Ability Test The PAT will consist of tasks geared to the daily job functions

4. 4th Quarter: Modified Work Capacity Test Personnel will wear a 25-pound pack and walk 3 miles within 46 minutes

State fire fighter certification is voluntary for all fire fighters (FFI and FFII). There is no annual recertification requirement. The FF was certified as a Fire Fighter II, Emergency Medical Technician, and in Ropes I, II, and III. She had 2 years of fire fighting experience.

Pre-placement Physical Examination. A pre-placement physical examination is required by this FD for all career applicants. The contents of the examination for full-time applicants are as follows:

- Complete medical history
- Physical examination
- Vital signs
- Blood testing: complete blood count and blood lipids
- Urinalysis
- Urine drug screen
- Spirometry
- Resting EKG
- EST
- Baseline chest x-ray
- Audiogram
- Vision test

Volunteer applicants receive the Department of Transportation (DOT) medical examination for commercial driver’s license (CDL), which does not include blood tests, spirometry, chest x-ray, or EST.

A District-contracted physician performs the medical examinations and forwards the clearance for duty decision to the Fire Chief, who makes the final determination regarding clearance for duty.

Periodic Evaluations. Annual medical evaluations are required for all members. The evaluation for full-time members is more stringent than the evaluation for volunteers. The components are the same as the



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pre-placement medical evaluation except a chest x-ray is not required unless clinically indicated. Again, volunteer members receive the CDL medical evaluation. Annual SCBA clearance is required. A District-contracted physician performs the medical evaluations and forwards the clearance for duty decision to the Fire Chief, who makes the final determination regarding clearance for duty.

An annual PAT and the US Forest Service pack test for Wildland Red Card certification are required for career and reserve members. There is a mandatory fitness program. A return-to-duty medical clearance is required from the fire fighter's PCP for duty-related injuries. A return-to-duty medical clearance is required from the fire fighter's PCP for illnesses that prevent fire fighters from performing their duty for three shifts. The clearance is provided to the FD, who reviews it and makes a final determination regarding return to work.

DISCUSSION

Oxycodone (Oxycontin) is a narcotic analgesic available in oral formulations often in combination with other drugs such as acetaminophen, aspirin, phenacetin, and caffeine.³ It is frequently used to treat pain, typically due to cancer or severe musculoskeletal injuries.² The usual adult dose is 2.5 - 5.0 mg every 6 hours, although patients with moderately severe pain may take 10 - 30 mg every 4 hours. The drug is also available in prolonged-release tablets containing 10 - 80 mg given every 12 hours. Therapeutic blood levels are less than 0.1 mg/L.² The FF/EMT had a blood level over 8 times the therapeutic maximum.

In human subject testing, plasma oxycodone concentrations peak somewhere between 0.8-2.5 hours post-dose.³ In subjects receiving an unusually large dose (20 mg in a 154-pound person), peak plasma concentrations averaged 0.038 mg/L at an average time of 1 hour.³ Subjects receiving single 40 or 80 mg controlled-release tablets attained average maximal plasma levels of 0.039 and 0.099 mg/L.³

Oxycodone is capable of producing stupor, coma, muscle flaccidity, severe respiratory depression, hypotension, and cardiac arrest in overdosage. Little is known about the postmortem toxicology or pathology of oxycodone-related deaths. In a series of 24 deaths attributed solely to oxycodone, postmortem blood concentrations averaged 1.2 mg/L (range 0.1-8.0).³ While this FF/EMT's oxycodone blood concentration was below this average, it was still within the fatal range.

This FF/EMT had a blood test at 0645 hours on the day of this incident as part of the FD annual medical evaluation. This blood test was negative for opiates (narcotics). Her blood level of oxycodone at autopsy was 0.85 mg/L. Witnesses who spoke to her at the meeting at 1700 hours stated that she exhibited no symptoms of having taken medication except for irritated eyes. Witnesses who saw her around dinner time stated she admitted to being very tired and was going to bed. Her husband, the last person to see the FF/EMT, stated she had no symptoms other than being tired. According to medical records available to NIOSH investigators, the FF/EMT was never prescribed oxycodone. It is unclear how she obtained the medication or why it was taken. The County Sheriff's Office determined the death to be accidental.

On autopsy, the FF/EMT was found to have mitral valve thickening and some cardiac muscle interstitial fibrosis. It is unlikely either of these findings were related to her sudden death.

According to crew members, the FF/EMT related she was taking a new vitamin and it was causing a rash. The NIOSH investigator was unable to obtain any information about this vitamin and it was not detected on the drug screen during her FD medical evaluation that morning nor by the autopsy.

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, the National Fire Protection As-



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sociation (NFPA) developed NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.⁴ NFPA 1582 lists narcotic use as a Category A medical condition for candidates and a condition that potentially interferes with fire fighting duties for members.⁴ Had the FD or the FD physician known of its use, she probably would not have been cleared for unrestricted fire fighting duties.

RECOMMENDATIONS

NIOSH investigators offer the following recommendations to address general safety and health issues although they probably would not have prevented this death:

Recommendation #1: Provide pre-placement and annual medical evaluations to ALL fire fighters to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

The FD requires a comprehensive pre-placement and periodic physical examination for career applicants and members and is commended for doing so. Volunteer applicants and members receive the DOT CDL physical examination, which is less stringent.

Guidance regarding the content and frequency of pre-placement and periodic medical evaluations and examinations for structural fire fighters can be found in NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*,⁴ in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) *Wellness/Fitness Initiative*,⁵ and the National Volunteer Fire Council (NVFC) *Health and Wellness Guide*.⁶ However, the FD is not legally required to follow any of these standards.

Applying NFPA 1582 involves economic issues. These economic concerns go beyond the costs of administering the medical program; they involve

the personal and economic costs of dealing with the medical evaluation results. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, Chapters 8-7.1 and 8-7.2⁷ and the NVFC *Health and Wellness Guide*⁶ address these issues.

We recommend the FD expand the medical evaluation program to include volunteers. The physical evaluation could be conducted by the fire fighter's primary care physician or a District-contracted physician. If the evaluation is performed by the fire fighter's primary care physician, the results must be communicated to the District physician, who makes the final determination for clearance for duty.

Recommendation #2: Ensure fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting.

Physicians who provide input regarding medical clearance for fire fighting duties should be knowledgeable about the physical demands of fire fighting and that fire fighters frequently respond to incidents in environments that are immediately dangerous to life and health. They should also be familiar with a FF's personal protective equipment and the consensus guidelines published by NFPA 1582, *Standard on Comprehensive Occupational Medicine Program for Fire Departments*.⁴ Primary care physicians provide return to work clearances for this FD. To ensure physicians are aware of these guidelines, we recommend that the FD, or the FF, provide the personal physicians with a copy of NFPA 1582.

We also recommend the District physician review all medical clearances, and not necessarily accept the opinions of specialists or other treating physicians regarding return to work. This decision requires knowledge not only of the medical condition, but also of the fire fighter's job duties. Personal physicians may not be familiar with an employee's job duties, or with guidance documents such as NFPA 1582. In addition, they may consider themselves patient advocates and dismiss the potential public health impact of public safety officials who may be suddenly incapacitated.



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Therefore, we recommend that a “FD physician” who has the final decision regarding medical clearance review all return-to-work clearances.

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