



Fire Chief Suffers Sudden Death During Training – Alabama

SUMMARY

On May 13, 2004, a 28-year-old male volunteer Fire Chief was attending an emergency medical services (EMS) conference in another state. The first night after arriving at the training city, the Chief and his wife went to bed at 2230 hours. The next morning, at 0900 hours, the Chief's spouse awoke and found the Chief deceased. She called 911 and an ambulance responded. From the Chief's clinical condition, it was obvious he had expired some time earlier. Cardiopulmonary resuscitation (CPR) and advanced life support (ALS) treatment were not performed, and he was pronounced dead at the scene by the medical examiner. The death certificate and the autopsy, completed by the Chief Medical Examiner, listed "accidental multiple drug intoxication" as the cause of death. The NIOSH investigator's review supports this conclusion.

NIOSH investigators offer the following recommendations to address general safety and health issues:

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.

Provide fire fighters with medical clearance to wear self-contained breathing apparatus (SCBA).

*Phase in a **MANDATORY** wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*

Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.

Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of firefighting, the personal protective equipment used by fire fighters, and the various components of the National Fire Protection Association (NFPA) 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments (FDs).

INTRODUCTION & METHODS

On May 13, 2004, a 28-year-old male volunteer Fire Chief suffered sudden death while attending a training conference. NIOSH was notified of this fatality on May 17, 2004, by the United States Fire Administration. NIOSH contacted the affected FD on June 7, 2004, to obtain further information, and on December 16, 2005, to initiate the investigation. On January 9, 2006, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Alabama to conduct an on-site investigation of the incident.

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

- Current FD Chief
- FD crew members
- Deceased Chief's mother
- Deceased Chief's wife

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 Web site at

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Fire Chief Suffers Sudden Death During Training – Alabama

The NIOSH investigator reviewed the following documents:

- FD training records
- FD standard operating guidelines
- Ambulance report
- Death certificate
- Autopsy report
- Hospital records
- Primary care physician (PCP) records

INVESTIGATIVE RESULTS

On May 11, 2004, the Fire Chief attended an FD board meeting at which he was authorized to attend a nearby fire conference and then travel to an EMS conference out of state. Witnesses stated that the Chief appeared jaundiced (yellow coloring of the skin) at the meeting. On May 12, 2004, a fire fighter picked up the Chief at his home at about 0845 hours and drove to the fire conference. At about 1200 hours, the Chief's wife picked him up at the fire conference and drove about six hours to the EMS conference city. The Chief slept the entire trip.

Upon arriving at the EMS conference city, the couple checked into the hotel. They requested a room without stairs because of the Chief's difficulty climbing stairs due to chronic low back pain. They went to a grocery store to obtain food for their stay, and the Chief ambulated well with a cane during this outing. After arriving back at the hotel, friends of the couple stopped by for a visit. About 2230 hours, they assisted the Chief in getting into bed and his spouse gave him some, not all, of his prescription medications for back pain. (The Chief was prescribed MS Contin® (a narcotic pain reliever) 60 mg twice daily, Robaxin® (a muscle relaxant) 750 mg every 6 hours as needed, Flexeril® (a muscle relaxant) 5 mg as needed, Valium® (antianxiety) 20 mg three times daily, Effexor® (antidepressant) 37.5 mg four times daily, Neurontin® (an anticonvulsant) 300 mg five times daily, Ambien® (insomnia medication) 20 mg at bedtime, and Paxil® (antidepressant) 40 mg at bedtime.) The Chief arose about 40 minutes later and requested something to

drink. After drinking some fluids, the Chief went back to bed. His spouse went to bed some time later.

On May 13, 2004, at about 0430 hours, the Chief's wife awoke to hear him snoring. After going back to sleep, she awoke at 0910 hours, thinking the alarm clock failed to awake them. She got up, looked at the Chief, and saw that he was not responsive. Assessing him, she found him not breathing, pulseless, and his pupils were dilated. She called 911, and an ambulance was dispatched at 0914 hours.

The ambulance arrived on the scene at 0933 hours. Assessment of the Chief revealed he was unresponsive, pulseless, and with no respirations. Clinical signs indicated the Chief had died some time earlier and no attempt at resuscitation was made. The ambulance crew notified Dispatch of the situation; Dispatch notified the Medical Examiner who responded and pronounced the Chief dead.

Medical Findings. According to medical records dating back to 1993, the Chief experienced intermittent hypertension (high blood pressure) and began smoking cigarettes in 1994. The Chief was not prescribed anti-hypertensive medications; and at the time of his death, he was smoking a couple of cigarettes per day. In 2001, the Chief suffered a back injury while working at a hazardous materials cleanup company. During the ensuing three years, the Chief underwent three back surgeries and numerous epidural blocks without lasting success. He was prescribed a variety of medications to control his pain, insomnia, depression, and anxiety.

The death certificate and the autopsy report, completed by the Chief Medical Examiner, listed "accidental multiple drug intoxication" as the cause of death. Pertinent findings from the autopsy, performed on May 13, 2004, included the following:

- Enlarged heart (cardiomegaly): heart weighed 520 grams (g) (normal is <400 g)¹
- Mild atherosclerosis



Fire Chief Suffers Sudden Death During Training – Alabama

- Moderate to marked pulmonary edema
- No evidence of thrombus in the coronary arteries
- No evidence of thrombo-emboli in the pulmonary arteries
- Positive blood tests for diazepam (Valium®), morphine (MS Contin®), venlafaxine (Effexor®) and methocarbamol (Robaxin®)
- Positive urine test for gabapentin (Neurontin®)

No microscopic examinations were performed.

The Chief was 69 inches tall and weighed 224 pounds, giving him a body mass index (BMI) of 33 kilograms per square meter (kg/m²). A BMI between 30.0 and 39.9 is considered obese.² According to the Chief's wife, he did not express symptoms of chest pain or any other cardiac problems when he went to bed.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this FD consisted of 28 uniformed personnel (3 career fire fighters and 25 volunteers), served a population of 3,000 in a 125 square-mile area, and had 3 fire stations.

Hiring, Membership and Training. The FD requires all career and volunteer fire fighter applicants to be at least 19 years of age, possess a valid State driver's license, have a high school diploma or equivalent, pass a drug screen, complete a police record check and a background evaluation, and be in good health and physically fit. Career applicants must be State certified as a Fire Fighter 1 (FF1), Paramedic, Apparatus Operator (A/O), and must have completed the Emergency Vehicle Operator Course. Newly-hired career fire fighters work 12-hour shifts, Monday through Friday, 0700 hours to 1900 hours. Volunteer fire fighter applicants must complete a job task assessment (physical ability test) and pass a written test relating to fire service tasks prior to being selected as a member. The new volunteer member must complete 20 hours of training prior to respond-

ing to calls. Members must obtain FF1, Hazardous Materials, A/O, and CPR (State 160-hour course) within 1 year.

The Chief was certified as a Fire Fighter 2, Driver/Operator, Fire Service Instructor, Paramedic, and trained to the Hazardous Materials Operations level. He had 14 years of fire fighting experience; he also had been a career fire fighter and a supervisor with an environmental cleanup company.

Pre-placement and Periodic Medical Evaluations.

No pre-placement or periodic medical evaluation is required by this FD. However, all applicants must be in excellent health and physically fit (self-reported).

Periodic Evaluations. No self-contained breathing apparatus (SCBA) medical clearance is required; however annual fit tests are performed. No annual physical agility test is required. There is no wellness/fitness program, but some exercise equipment (strength and aerobic) is available at the fire stations. A return-to-duty medical clearance is required from the member's attending physician for duty-related injuries and non-duty-related illnesses if the illness prevents fire fighters from performing their duty. The clearance is provided to the Fire Chief, who reviews it and makes a final determination regarding return to work.

DISCUSSION

Morphine (MS Contin®) (morphine sulfate) is a narcotic analgesic, popular for the treatment of moderate to severe pain.³ Oral preparations include pills taken in doses of 5 mg-30 mg every 4 hours; or sustained-release tablets/capsules contain 15 mg-200 mg and are taken at 8-24 hour intervals.³ The depressant effects of morphine are potentiated by the presence of other central nervous system depressants such as sedatives, antihistamines, or psychotropic drugs.⁴ Adverse or toxic effects of morphine usage include constipation, urinary retention, nausea, vomiting, respiratory depression, coma and pulmonary edema.³ The Chief was prescribed 60 mg



Fire Chief Suffers Sudden Death During Training – Alabama

time-release capsules. The therapeutic blood level is 10 nanograms per milliliter (ng/mL)-80 ng/mL; the toxic blood level is >200 ng/mL. The Chief's blood level of morphine was <50 ng/mL; well within the therapeutic range.

Methocarbamol (Robaxin®) is a carbamate derivative used occasionally as a sedative or muscle relaxant. It may be administered orally in single doses of 500 mg-1500 mg and daily doses of 4 g-8 g. One oral formulation contains 400 mg of methocarbamol and 325 mg of aspirin.^{5,6} Overdosage with methocarbamol results in nausea, drowsiness, hypotension, and coma.^{5,6} Upon the advice of his physician, the Chief discontinued this medication 1 month prior to his death.

Cyclobenzaprine (Flexeril®) is a centrally-acting skeletal muscle relaxant. The drug is supplied as the hydrochloride salt in 10 mg tablets for oral use; daily doses range from 30 mg-60 mg, but are not recommended for periods of longer than 2-3 weeks.⁷ The Chief had been prescribed cyclobenzaprine 5 mg for 1 month prior to his death, but no blood level of cyclobenzaprine was detected at the Chief's autopsy.

Diazepam (Valium®) is administered as an anti-anxiety agent, muscle relaxant, or anticonvulsant in single doses of 2 mg-20 mg, and up to 40 mg daily.^{8,9} It is supplied as the free base in 2 mg, 5 mg, and 10 mg tablets for oral administration. The serum of un-medicated humans has been shown to contain diazepam and its major active metabolites at concentrations of 1 nanogram per liter (ng/L)-32 ng/L, possibly as a result of the natural presence of benzodiazepines in certain foods.^{8,9} The Chief was prescribed diazepam 20 mg every 8 hours 1 month prior to his death. His blood concentration at autopsy was 514 ng/mL, well within the therapeutic range of 100 ng/mL-1000 ng/mL.

Venlafaxine (Effexor®) is an antidepressant. Daily oral doses are normally in the range of 75 mg-225 mg.^{10,11} Adverse effects resulting from venlafaxine administration include nausea, vomiting, dizziness, nervousness, anxiety, tremor and blurred vision. Overdosage may

cause hypertension or hypotension, cardiac arrhythmia, seizures and coma.^{10,11} The Chief was prescribed 37.5 mg every 6 hours and had a trace blood level at autopsy.

Gabapentin (Neurontin®) is used as an anticonvulsant drug. It is indicated as adjunctive therapy in the treatment of partial seizures in adults with epilepsy and is being evaluated for the relief of neuropathic pain.¹² Gabapentin is not metabolized, does not bind to plasma proteins and, once absorbed, is eliminated solely by renal excretion. A single oral dose is eliminated as unchanged drug in the urine (76%-81%) and feces (10%-23%) over a 4-day period.¹² The most commonly observed adverse reactions associated with the use of gabapentin are somnolence, dizziness, ataxia, fatigue and nystagmus. Other adverse reactions have included palpitation, high and low blood pressure, weight increase or weight loss.¹² The Chief was prescribed 300 mg five times daily and a urine test at autopsy was positive.

The Chief was also prescribed Ambien® (zolpidem tartrate) for insomnia and Paxil® (paroxetine HCL), an antidepressant, but these medications were not identified in toxicological testing at autopsy.

Cardiomegaly. On autopsy, the Chief had an enlarged heart. This condition has been linked to dilation, hypertrophy, myocardial infiltrations, or any combination of these factors¹³ and sudden cardiac death.¹⁴ Cardiac dilation (or dilatation) is an increased volume of any cardiac chamber or combination of chambers, usually leading to an increased size of the heart, and is caused by a variety of pathological entities.¹⁵ Thus, chamber dilation may be global in dilated cardiomyopathy. Cardiac dilation is one of the two causes of cardiomegaly, the other being myocardial hypertrophy.¹⁵ Hypertrophy of the heart's left ventricle (LVH) is a relatively common finding among individuals with long-standing high blood pressure (hypertension), a heart valve problem, or cardiac ischemia (reduced blood supply to the heart muscle).¹ LVH increases the risk for sudden cardiac death. The autopsy listed the cause for the Chief's



Fire Chief Suffers Sudden Death During Training – Alabama

sudden death as accidental prescription medication overdose; although, cardiomegaly cannot be ruled out as a cause of death. While the blood levels of medications were at the “therapeutic level,” the most likely cause of death was the mixture of so many medications. At no time, however, did the Chief exceed the daily recommended dosages. In fact, the night before his death, the Chief’s wife did not give him all of his medications for that night.

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, NFPA developed NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.¹⁶ NFPA 1582 considers spine fusion at two or more levels placing the spine at risk for future degenerative changes; any spinal condition with significant radiculopathy resulting in peripheral motor weakness, loss of strength, loss of sensation, and loss of reflexes.

Another issue is the use of narcotics or muscle relaxants (to treat any spinal condition) to be conditions which could prevent a fire fighter from safely performing such essential job tasks as: firefighting, wearing an SCBA, climbing six or more flights of stairs while wearing turnout gear and equipment weighing 50 pounds or more, victim search and rescue, advancing charged hose lines, climbing ladders, and functioning as an integral part of a two-in/two-out team.¹⁶ The Chief, as a supervisor, did not perform these functions and had been on light-duty since his injury.

RECOMMENDATIONS

NIOSH investigators offer the following recommendations to address general safety and health issues:

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.*

Guidance regarding the content and frequency of periodic medical evaluations and examinations for structural fire fighters can be found in NFPA 1582,¹⁶ in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) *Wellness/Fitness Initiative*,¹⁷ and the National Volunteer Fire Council (NVFC) *Health and Wellness Guide*.¹⁸ Although the FD is not legally required to follow any of these standards, they provide effective guidelines for implementing a medical evaluation requirement.

Applying this recommendation involves economic repercussions and may be particularly difficult for small, rural, volunteer FDs to implement. 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*, Chapter 8-7.1 and 8-7.2,¹⁹ and the NVFC *Health and Wellness Guide*¹⁸ address these issues.

Recommendation #2: *Provide fire fighters with medical clearance to wear SCBA.*

The Occupational Safety and Health Administration (OSHA)’s *Revised Respiratory Protection Standard* requires employers to provide medical evaluations and clearance for employees using respiratory protection.²⁰ Such employees include fire fighters who utilize SCBA in the performance of their duties. These clearance evaluations are required for private industry employees and public employees in states operating OSHA-approved state plans. Alabama is not a state-plan state and public sector employers are not required to comply with OSHA standards. However, we recommend voluntary compliance.

Recommendation #3: *Phase in a MANDATORY wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*



Fire Chief Suffers Sudden Death During Training – Alabama

NFPA 1500 requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.¹⁹ NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Fighters*, provides the minimum requirements for a health-related fitness program.²¹ In 1997, IAFF/IAFC published a comprehensive Fire Service Joint Labor Management *Wellness/Fitness Initiative* to improve fire fighters' quality of life and maintain physical and mental capabilities of fire fighters. Ten FDs across the United States joined this effort to pool information about their physical fitness programs and create a practical fire service program. They produced a manual and a video which detail elements of such a program.¹⁷ Large-city negotiated programs can also be reviewed as potential models. Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.²²⁻²⁴ A similar cost savings has been reported by the wellness program at the Phoenix FD, where a 12-year commitment has resulted in a significant reduction in the department's disability pension costs.²⁵ The NVFC *Health and Wellness Guide* provides guidance to volunteer FDs on how to administer a wellness/fitness program and its components.¹⁸

Recommendation #4: Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.

NFPA 1500 requires FD members who engage in emergency operations to be annually evaluated and certified by the FD as having met the physical performance requirements identified in paragraph 8-2.1.¹⁹ This recommendation is focused toward those performing structural fire fighting, not those in a supervisory capacity. However, the supervisor must still be capable of responding and performing such duties as necessary at emergency scenes.

Recommendation #5: Ensure that fire fighters are cleared for duty by a physician knowledgeable about

the physical demands of firefighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.

The physical evaluation could be conducted by the fire fighter's PCP or a City/County-contracted physician. If the evaluation is performed by the fire fighter's primary care physician, the results must be communicated to the City or County physician, who makes the final determination for clearance for duty.

Physicians providing input regarding medical clearance for firefighting duties should be knowledgeable about the physical demands of firefighting and should recognize that fire fighters frequently respond to incidents in environments that are immediately dangerous to life and health (IDLH). They should also be familiar with a fire fighter's personal protective equipment and the consensus guidelines published by NFPA 1582.¹⁶ In order to ensure physicians are aware of these guidelines, we recommend that the FD, or the fire fighter, provide PCPs with a copy of NFPA 1582. We also recommend the FD retain an "FD Physician" to critically review all medical clearances. This decision requires knowledge not only of the medical condition, but also of the fire fighter's job duties. PCPs may not be familiar with an employee's job duties, or guidance documents, such as NFPA 1582. In addition, they may consider themselves to be patient advocates and may dismiss the potential public health impact of public safety officials who may become suddenly incapacitated. The Chief's physicians were aware that he was a fire fighter.

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Fire Chief Suffers Sudden Death During Training – Alabama

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Fire Chief Suffers Sudden Death During Training – Alabama

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