



April 21, 2007

Fire Fighter Dies During the Night After Responding to a Structural Fire—Pennsylvania

SUMMARY

On December 7, 2006, a 25-year-old male volunteer fire fighter responded to a restaurant fire. On-scene, the fire fighter helped remove part of a wall to access burning wires. Units returned to their station one hour later, and the fire fighter returned home for the evening. At 0111 hours on the next morning (December 8th), the fire department was dispatched to a residence for a gas odor. The fire fighter's roommates responded to the call, but he did not. Thinking the fire fighter had slept in, the roommates did not check on him when they returned home at approximately 0145 hours. The roommates left for work later in the morning, but the fire fighter still had not risen. When a roommate returned home at approximately 1840 hours, he and the fire fighter's girlfriend entered the house and the fire fighter's room and found him unresponsive. An ambulance and police were summoned, but the fire fighter was dead. The deputy coroner was notified and pronounced the fire fighter dead. The death certificate and autopsy (completed by the forensic pathologist) listed "sudden unexplained death in epilepsy" as the cause of death.

NIOSH investigators offer the following recommendations to address general safety and health issues. If the fire company had implemented the following recommendations, perhaps the annual medical evaluation would have resulted in better medical compliance of his anti-seizure medication, and thus his death may have been prevented at this time.

- *Perform pre-placement and periodic medical evaluations consistent with National Fire Protection Association (NFPA) 1582, Standard on Comprehensive Occupational Medical Program for fire departments.*
- *Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.*
- *Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatus (SCBAs).*
- *Develop a structured wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*

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

<http://www.cdc.gov/niosh/fire/>

or call toll free

1-800-CDC-INFO (1-800-232-4636)

INTRODUCTION AND METHODS

On December 8, 2006, a 25-year-old male volunteer fire fighter died in his sleep after responding to a structure fire. NIOSH was notified of this fatality on December 12, 2006 by the United States Fire Administration. NIOSH contacted the affected fire department on December 14, 2006, to obtain further information and on January 16, 2007, to initiate the investigation. On February 12, 2007, a safety and occupational health specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Pennsylvania to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- Career fire department chief
- Volunteer fire company chief
- Crew members
- Fire fighter's roommates
- Fire fighter's parents

NIOSH personnel reviewed the following documents:

- Fire department incident reports
- 9-1-1 dispatch records and audio tape
- Witness statements
- Fire department training records
- Fire department annual 2006 response report
- Fire department standard operating guidelines
- Ambulance report
- Police report
- Hospital records

- Death certificate
- Autopsy report
- Primary care provider medical records

RESULTS OF INVESTIGATION

On December 7, 2006, the fire department was dispatched to a structure fire at 2028 hours. Equipment and personnel (4 engines, 2 ladder trucks and 36 personnel) from two stations (Stations 25 and 26) responded to the call, arriving on-scene at 2036 hours. The structure was a restaurant located in a strip mall (Photograph 1). Inside, fire fighters detected the odor of burning electrical wiring and saw smoke emanating from an electrical receptacle.



Photograph 1. Restaurant located in a strip mall.

Fire fighters, wearing full bunker gear and SCBA, removed a wall panel with a “saws-all” to locate the origin of the odor (overheated wiring inside the wall) (Photograph 2). The area of work was very confining and after accessing the wires, the fire fighter disconnected the receptacle. The fire fighter also checked surrounding electrical receptacles for operability and opened additional wall areas

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to check for fire. The entire operation took about 45 minutes. The emergency was declared under control, and units departed the scene at 2153 hours.



Photograph 2. The origin of the odor (overheated wiring inside the wall).

The fire fighter returned to the station in Engine 26 and then returned home at about 2230 hours. The fire fighter, his girlfriend, and two roommates (also fire fighters) watched television until about 2400 hours. The girlfriend left the home, and the fire fighter and his roommates went to sleep in their respective bedrooms at about 0045 hours.

At 0111 hours, the neighboring fire company was dispatched for a gas leak. The fire fighter and his roommates were also members of this fire company. As the roommates responded to the call, they noticed the fire fighter was not responding with them. However, this was not uncommon because of the nature of the call and the time of day. The roommates returned from the call at about 0200 hours and knocked on the fire fighter's door to "harass" him for not responding to the call. The fire fighter did not answer the door.

The fire fighter's alarm clock alarmed at 0730 hours and eventually turned itself off. This also was not uncommon, as the fire fighter sometimes did not readily awaken. The roommates arose and left for work between 0800 hours and 0900 hours. The fire fighter's girlfriend tried to telephone him at home throughout the day, but did not get a response. One roommate returned home at about 1800 hours and was immediately dispatched to a fire alarm. When he returned home at about 1830 hours, he noticed the fire fighter's vehicle was parked in the driveway. The roommate and the fire fighter's girlfriend entered the house and the fire fighter's bedroom and found him obviously deceased. They called 9-1-1, and an ambulance and police officers were dispatched at 1842 hours.

Police officers arrived on-scene at 1844 hours and found the fire fighter deceased in bed, and "evidence consistent with a person who had a seizure during their sleep and had asphyxiated." The deputy coroner was contacted, and pronounced the fire fighter dead at 2025 hours over the telephone.

Medical Findings. The death certificate and autopsy (completed by the forensic pathologist) listed "sudden unexplained death in epilepsy" as the cause of death. Pertinent findings from the autopsy, performed on December 9, 2006, included the following:

- Normal-sized heart, 380 grams (g) (normal <400 g) [Siegel 1997]
- Brain was slightly swollen, congested, and "dusky" in color
- No plaque, atherosclerosis, or blood clots in any of the coronary arteries



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- No evidence of a pulmonary embolus (blood clot in the lung arteries)
- Negative alcohol tests
- Drug testing was positive for prescription medication carbamazepine (1.2 micrograms [μg] per milliliter [mL]) (therapeutic level is 8.0 $\mu\text{g}/\text{mL}$ –12.0 $\mu\text{g}/\text{mL}$)

These autopsy findings did not point to a definitive cause of death; therefore, the forensic pathologist concluded the fire fighter most likely died of “sudden unexplained death in epilepsy.”

The fire fighter had a long history of a seizure disorder (epilepsy). A neurologist and a primary care physician had been following him for this condition since 1990. He was maintained on the anti-seizure prescription medication carbamazepine (800 milligrams per day). According to interviews and records available to NIOSH at the time of this report, the fire fighter had 2 seizures within the past 5 years (in October 2002 and July 2005). The seizures were attributed to non-compliance with taking the prescription medication. He was last seen by a physician in June 2006, at which time the fire fighter had a syncopal episode after receiving a hepatitis A vaccination. During this hospital visit, the fire fighter’s carbamazepine level was low, 3.0 $\mu\text{g}/\text{mL}$, probably due to medication non-compliance. The contract physician, who had conducted the post-offer/pre-placement medical evaluations for the neighboring fire company, did not have a record of any visit or medical evaluation of this fire fighter, even though he was a member of the neighboring fire company for 7 years.

DESCRIPTION OF THE FIRE COMPANY

At the time of the NIOSH investigation, this volunteer fire company consisted of 44 uniformed personnel, served a population of 4,200 in a 0.5-square-mile area, and had 1 fire station. In 2006, the fire company responded to 204 calls including 15 structure fires, 4 brush fires, 3 vehicle fires, 4 rubbish fires, 3 other fires, 6 medical/rescue calls, 23 hazardous condition calls, 90 false alarm calls, 45 good intent calls, 5 service calls, and 3 severe weather calls.

Membership and Training. The fire company requires the following of all fire fighter applicants:

- Complete an application
- Possess a valid State driver’s license
- Possess a high school diploma or equivalent
- Pass a background check
- Complete a medical history report
- Pass a physical ability test

The application is reviewed by the officers, and the successful applicant is accepted into the fire company and placed on probation for 4 months. The new fire fighter must attend drills, take an active role, and is enrolled in the 160-hour Fire Essentials Program, which trains the fire fighter to the Fire Fighter I and II levels. The State minimum standard for fire fighter certification is the Essentials program.

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The fire fighter was certified as a Fire Fighter II, driver/operator, and a hazardous materials technician. He had 7 years of fire fighting experience.

Pre-placement and Periodic Medical Evaluations. No pre-placement or periodic medical evaluations are required by this fire company. Medical clearance for SCBA use is not required. If someone is injured at work, a return-to-duty medical clearance is required from the city's worker's compensation panel. If a non-duty-related illness prevents a fire fighter from performing his or her duty, a return-to-duty clearance may be required from the worker's compensation panel, which makes the final clearance decision.

Health/Wellness. An annual physical agility test is required for members. There is a voluntary wellness/fitness program, and fire fighters have free access to a local fitness center.

DISCUSSION

Epilepsy is defined as a condition characterized by two or more unprovoked seizures. Epileptics can be categorized by the following seizure characteristics:

- Frequency: in-remission versus active (active is defined as more than one seizure over the past 5 years)
- Etiology (cause): idiopathic (unknown) versus remote symptomatic (central nervous system lesion with or without neurodeficits) [Commission on Epidemiology and Prognosis 1993]
- Seizure type: generalized tonic-clonic (GTC), partial, other

The fire fighter's partial epilepsy was thought to have been caused by a fall from a wall when he was 10 years old.

The overall death rate of epileptics is significantly increased relative to the general population, with epileptics having up to a three-fold higher death rate [Forsgren et al. 2005]. The following seizure characteristics have been consistently associated with an increased death rate among epileptics: etiology (remote symptomatic > idiopathic), seizures type (GTC > partial or other), and duration (short and long > intermediate) [Cockerell et al. 1994; Olafsson et al. 1998; Loiseau et al. 1999; Lindsten et al. 2000]. The death of patients with epilepsy may be unrelated to epilepsy, related to the underlying cause of epilepsy, or related to seizures. In most cases the increased death rate observed in epileptics is primarily due to the underlying cause of epilepsy [Cockerell et al. 1994].

Sudden unexpected death in epilepsy (SUDEP) is a term defined as "sudden, unexpected, witnessed or un-witnessed, non-traumatic and non-drowning deaths in patients with epilepsy, with or without evidence of a seizure and excluding documented status epilepticus, in which post-mortem examination does not reveal a toxicologic or anatomic cause of death [Nashef 1997]." The mechanism is unclear, but it may involve autonomic or cardiorespiratory disturbances [Schraeder and Lathers 1989; Nashef et al. 1996]. Rates of SUDEP range from 0.3 to 1.0 per 1,000 person-years in unselected populations [Leestma et al. 1997; Annegers et al. 1984; Tomson and Kenneback 1997; Tomson et al. 1998], to rates as high as 10 per 1,000 person-years in high-risk individuals (e.g., surgical candidates for refractory seizures) [Racoosin et al. 2001; Annegers et al. 1998]. In one study, the rate of



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SUDEP among 20-40 year olds was 24 times the rate of sudden death among 20–40 year olds in the general population. When witnessed, only GTC seizures have been reported with SUDEP [Leestma et al. 1997]. In addition to GTC seizures, risk factors for SUDEP include seizure frequency (>1 seizure during the year of observation), seizure onset at an early age, and long duration of the seizure disorder [Tomson et al. 2005]. The fire fighter had two of these risk factors (long duration and GTC seizure).

Although the fire fighter met the case definition and had two risk factors for SUDEP, since his event was not witnessed, it is not possible to determine definitively that his death was seizure related. Thus, NIOSH investigators agree with the conclusion of the coroner who determined the “most likely” cause of death to be “sudden unexplained death in epilepsy.”

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of sudden death or other incapacitating medical conditions among fire fighters, the NFPA developed NFPA 1582. NFPA 1582 lists epilepsy with a seizure during the previous 5 years as a precluding condition for applicants because it “interfere[s] with a member’s ability to safely perform essential job tasks....” [NFPA 2007]. Before joining the fire company in 1999, the fire fighter had experienced a seizure in 1995. Therefore, if the Fire Companies had been following NFPA 1582, as a fire fighter candidate, he would not have been medically cleared.

If a current fire company member develops epilepsy, NFPA 1582 has the same requirements. The fire fighter had experienced two seizures within the past 5 years: October 2002 and July 2005. Again, if the fire company

had been following NFPA 1582, as a current member, he would not have been medically cleared for unrestricted duty. Because the fire department did require pre-placement or annual medical evaluations, the city’s worker’s compensation panel had no knowledge of the fire fighter’s seizure disorder (epilepsy) and his prescribed anti-seizure medications. Had the panel physicians been notified of this condition, perhaps the fire fighter would have been re-assigned to duties within the fire department and/or been required to have closer blood monitoring of his anti-seizure medications. However, re-assigning the fire fighter to alternate duty is unlikely to have prevented his death. More frequent monitoring of his anti-seizure medications and/or better medication compliance as part of a fire company annual medical evaluation, however, may have prevented the fire fighter’s death at this time.

RECOMMENDATIONS

NIOSH investigators offer the following recommendations to address general safety and health issues. If the fire company had implemented the following recommendations, perhaps the annual medical evaluation would have resulted in better medical compliance of his anti-seizure medication, and thus his death may have been prevented at this time.

Recommendation 1: Perform pre-placement and periodic medical evaluations consistent with NFPA 1582.

NFPA 1582 requires fire departments to conduct pre-placement and annual medical evaluations. Guidance regarding the content and frequency of these evaluations can be found in NFPA 1582 [NFPA 2007] and in the International Association of Fire Fighters



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(IAFF)/International Association of Fire chiefs (IAFC) *Fire Service Joint Labor Management Wellness/Fitness Initiative* [IAFF, IAFC]. However, the fire company is not legally required to follow this standard or this initiative.

Applying this recommendation involves economic repercussions and may be particularly difficult for small, volunteer fire companies to implement. NFPA 1500, *Standard on fire department Occupational Safety and Health Program*, Chapters 8–7.1 and 8–7.2 [NFPA 2002] and the National Volunteer Fire Council (NVFC) *Health and Wellness Guide* [USFA 2004] address these issues.

To overcome the financial obstacle, the fire company could urge current members to get annual medical clearances from their private physicians. Another option is having the annual medical evaluations completed by other members of the volunteer fire company (medical and occupational history) and by paramedics and emergency medical technicians (EMTs) from the emergency medical service (vital signs, height, weight, visual acuity, and electrocardiogram [EKG]). This information could then be provided to a community physician, perhaps volunteering his or her time, to review the data and provide medical clearance (or further evaluation, if needed). The more extensive portions of the medical examinations could be performed by a private physician at the fire fighter's expense, provided by a physician volunteer, or paid for by the fire company. Sharing the financial responsibility for these evaluations between volunteers, the Firefighters Relief Association, and physician volunteers may reduce the negative financial

impact on recruiting and retaining needed volunteers.

Recommendation 2: Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the various components of the NFPA 1582.

Guidance regarding medical evaluations and examinations for structural fire fighters can be found in NFPA 1582 [NFPA 2007] and in the report of the IAFF/IAFC *Fire Service Joint Labor Management Wellness/Fitness Initiative* [IAFF, IAFC 2000]. According to these guidelines, the fire company should have an officially designated physician who is responsible for guiding, directing, and advising the members with regard to their health, fitness, and suitability for duty as required by NFPA 1500 [NFPA 2002]. The physician should review job descriptions and essential job tasks required for all fire company positions and ranks, in order to understand the physiological and psychological demands of fire fighters and the environmental conditions under which they must perform, as well as the personal protective equipment they must wear during various types of emergency operations.

Recommendation 3: Provide fire fighters with medical evaluations and clearance to wear SCBAs.

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 [29 CFR 1910.134]. Such employees include fire fighters who use SCBA. These clearance evaluations are required for private industry



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employees and public employees in States operating OSHA-approved State plans. However, Pennsylvania is not an OSHA State-plan State, and public sector employers are not required to comply with OSHA standards. Regardless, the NIOSH investigator recommends voluntary compliance.

Recommendation 4: Develop a structured wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.

Physical inactivity is the most prevalent modifiable risk factor for coronary artery disease (CAD) in the United States. Physical inactivity, or lack of exercise, is associated with other risk factors, including obesity and diabetes [Plowman and Smith 1997]. Although the fire fighter did not suffer from cardiovascular disease, this recommendation will help other members reduce CAD risk factors and improve their cardiovascular capacity. NFPA 1500 requires that a fire department have a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being [NFPA 2002]. Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days [Maniscalco et al. 1999; Stein et al. 2000; Aldana 2001]. Health promotion programs in the fire service have been shown to improve coronary artery disease (CAD) risk factors and fitness levels, with mandatory programs showing the most improvement [Blevins et al. 2006; Dempsey et al. 2002; Womack et al. 2005]. One mandatory program was able to show a cost savings of \$68,741 from reduced absenteeism [Stevens et al. 2002]. A similar cost savings has been reported by the wellness program at the

Phoenix fire department, where a 12-year commitment has resulted in a significant reduction in their disability pension costs [City Auditor 1997]. Guidance for implementation and components of a wellness/fitness program are found in NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Fighters* [NFPA 2000], in the IAFF/IAFC, *Fire Service Joint Labor Management Wellness/Fitness Initiative* [IAFF, IAFC 2000], and in the NVFC's *Health and Wellness Guide* [USFA 2004]. Given the structure of the fire fighter's fire company, the NVFC program might be the most appropriate model.

Currently, the fire company has a voluntary wellness/fitness program, and fire fighters have free access to a local fitness center. NIOSH recommends a formal, structured wellness / fitness program to ensure all members receive the benefits of physical exercise.

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INVESTIGATOR INFORMATION

This investigation was conducted by and the report written by:

*Tommy N. Baldwin, MS
Safety and Occupational Health Specialist*

Mr. Baldwin, a National Association of Fire Investigators (NAFI) Certified Fire and Explosion Investigator, an International Fire Service Accreditation Congress (IFSAC) Certified Fire Officer, a Kentucky certified firefighter and emergency medical technician (EMT), and a former fire chief, is with the NIOSH Firefighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio.