



## Fire Fighter Dies at the Scene of a Small Fire in an Apartment Building—Connecticut

### SUMMARY

On March 17, 1999, a 44-year-old male Fire Fighter responded to a fire in the basement of an apartment building. While opening walls to search for fire spread on the second and third floors, the victim had an unwitnessed collapse. He was found by one of the renovation workers, who summoned help. Despite cardiopulmonary resuscitation (CPR) and advanced life support (ALS) administered by first responders, a paramedic of his engine company, ambulance paramedics, and emergency department personnel, the victim died. His carboxyhemoglobin level was 2.1%, indicating he was not exposed to significant levels of carbon monoxide. The death certificate, completed by the State Medical Examiner, listed “atherosclerotic cardiovascular disease” as the immediate cause of death. No autopsy was performed.

Other agencies have proposed a three-pronged strategy for reducing the risk of on-duty heart attacks and cardiac arrests among fire fighters. This strategy consists of (1) minimizing physical stress on fire fighters; (2) screening to identify and subsequently rehabilitate high-risk individuals; and (3) encouraging increased individual physical capacity. Issues relevant to this fire department include the following:

- *Fire Fighters should have annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.*
- *Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by phasing in a mandatory wellness/fitness program for fire fighters.*

- *Perform an autopsy on all on-duty fire fighters whose death may be cardiovascular-related.*

### INTRODUCTION & METHODS

On March 17, 1999, a 44-year-old male Fire Fighter lost consciousness while he was opening walls to check for fire spread at the scene of a fire in an apartment building. Despite CPR and ALS administered by first responders and a paramedic of his engine company, ambulance paramedics, and emergency department personnel, the victim died. NIOSH was notified of this fatality on March 18, 1999, by the United States Fire Administration. On March 23, 1999, NIOSH contacted the affected Fire Department to initiate the investigation. On June 21, 1999, a Safety and Occupational Health Specialist and an Epidemiologist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Connecticut to conduct an on-site investigation of the incident.

During the investigation NIOSH personnel met with and interviewed the

- Deputy Fire Chief
- Training Officer

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. 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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- Local President of the International Association of Fire Fighters (IAFF)
- Crew members involved in this incident
- Victim's wife
- Director of the Employee Assistance Program

During the site visit NIOSH personnel also reviewed

- Existing FD investigative records, including the board of inquiry report, incident reports, coworker statements, and dispatch records
- The victim's fire department training records
- Emergency medical services—ambulance report
- The hospital's records of the resuscitation effort
- The death certificate
- The postmortem report (external exam only)
- Past medical records of the deceased
- FD policies and operating procedures
- FD training records
- The FD annual report for 1998

#### **INVESTIGATIVE RESULTS**

*Incident Response.* On March 17, 1999, at 1625 hours, Engine 3, Engine 4, Engine 7, Engine 16, Ladder 11, Ladder 5, Rescue 5, and Battalion Chief 1 were dispatched on a first- and second-due alarm to an apartment building with a fire reported in the basement. The building was a six-story brick structure containing 60 vacant apartments under renovation. Engine 3, staffed with four personnel (Captain, Engineer, and two Fire Fighters [including the victim]), was first to arrive on scene at 1627 hours. The Captain assumed command while the victim assisted the Engineer in connecting Engine 3 to the hydrant located in front of the apartment building. Engine 4 arrived on scene at 1628 hours, while the Captain and the other Fire Fighter from Engine 3 donned their SCBAs and pulled 150 feet of 1¾-inch hose line into the first floor of the building. They were met by a renovation worker who related that the fire started in a first-floor apartment at the rear of

the building. From 1629 to 1635 hours, four additional pieces of apparatus (Engine 7, Engine 16, Ladder 11, Ladder 5, and Rescue 5) and 22 fire personnel arrived. Ladder 11 and Rescue 5 reported to the scene and Engine 7, Engine 16, and Ladder 5 were placed into staging. Battalion Chief 1 arrived at 1630 hours.

At 1631 hours, Engine 3 notified Dispatch that they had located the area of fire and were checking for fire extension. Two fire fighters from Engine 4 were ordered into the building to assist Engine 3 personnel. After inspecting and clearing the first floor, crews from Engine 3 and Engine 4, accompanied by the renovation worker, continued their search for fire spread on the second floor, where they encountered light smoke conditions. At 1636 hours, Battalion Chief 1 took command of the scene as Incident Commander (IC). The victim donned his SCBA, without facepiece, and joined his Engine 3 crew members on the second floor. He began to open some walls to check for fire extension as the Ladder 11 crew began to ventilate the second and third floors.

At 1638 hours, the Engine 3 Captain radioed Incident Command (IC) that the second floor was clear. The victim proceeded to the third floor and entered an apartment to check for fire extension. The IC, accompanied by the renovation worker, joined the victim and the Ladder 11 crew on the third floor to assess the situation. The IC then returned to the second floor and at 1640 hours put in a recall and returned the staging companies to quarters. The renovation worker returned to the third-floor apartment and found the victim lying on the floor.

The worker tried to use the victim's portable radio to summon for help but was unsuccessful. He and another renovation worker began to carry the victim into the hallway while fire fighters on the second floor were notified by a third renovation worker that a fire



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fighter was down. Engine 3 crew members were the first to reach the victim. The Captain told the workers to put the victim onto the floor and immediately, at 1643 hours, called for a resuscitator for a fire fighter down and requested medics to the location. Fire Fighters retrieved resuscitation equipment (oxygen and bag-valve-mask) and proceeded to the third floor. A Fire Fighter/Paramedic and the Captain removed the victim's SCBA and turnout coat and found him to be unconscious and unresponsive. They checked for vital signs and found a weak carotid pulse and a respiratory rate of 12 times a minute. The Fire Fighter/Paramedic maintained the victim's airway until an oral airway was placed in his mouth and respirations were assisted with a bag-valve-mask (BVM).

The IC arrived on the third floor and rechecked the carotid pulse. He found no pulse and CPR was initiated. At 1648 hours, the ambulance arrived. A heart monitor was attached to the victim and ventricular fibrillation (a heart rhythm not able to sustain life) was revealed. Resuscitation efforts continued, including three defibrillations (shocks), intubation, CPR, and intravenous (IV) medications. The victim was placed onto a backboard, removed from the building, and placed into the ambulance. En route a fourth defibrillation was delivered, resulting in asystole (no heart beat).

The ambulance departed the scene at 1706 hours as CPR and ALS measures continued. On arrival in the emergency department (ED) at 1712 hours, the victim was reevaluated and found to be unconscious and unresponsive. His heart remained in asystole, and CPR and ALS measures were continued until 1722 hours, at which time the victim was pronounced dead and resuscitation measures were discontinued. A total of 39 minutes of CPR and ALS measures were performed on the victim: 23 minutes on scene, 6 minutes during transport to the hospital, and 10 minutes in the emergency department.

*Medical Findings.* The death certificate was completed by the State Medical Examiner, who listed "atherosclerotic cardiovascular disease" as the immediate cause of death. No autopsy was performed. Blood and urine were checked for drugs and found to be negative (only those used during the resuscitation efforts were present). His carboxyhemoglobin level was 2.1%, suggesting he was not exposed to significant levels of carbon monoxide. Past Fire Department medical records indicated that the victim had only four known risk factors (male gender, family history, history of smoking, and high cholesterol) for coronary artery disease (CAD). The family reported he maintained a fair amount of off-the-job aerobic activity without chest pain.

#### **DESCRIPTION OF THE FIRE DEPARTMENT**

At the time of the NIOSH investigation, the fire department was comprised of 373 uniformed personnel and served a population of 135,000 residents in a geographic area of 17 square miles. Fire Fighters work the following tour of duty in eight fire stations: Days 1-3, 0800-1800; Days 4-6, off duty; Days 7-9, 1800-0800; and off duty for 3 days. There are four work groups. Each shift of an engine and ladder company is staffed with an officer and three fire fighters. The victim was scheduled off duty on the day of the incident. He spent the morning at home relaxing and watching television with his spouse. Throughout the day, the victim did not report or show any signs of discomfort, pain, or distress. He was called for overtime and began his shift at 1600 hours. The incident described, which began at 1625 hours, was the victim's first emergency response during his shift.

In 1998, the department responded to 11,389 total calls: 4,319 medical calls, 2,466 false alarms, 1,240 fires or explosions, 990 service calls, 894 good-intent



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calls, 557 rescue calls, 534 hazardous materials calls, 282 hazardous conditions, 94 other situations, and 13 overpressure/ruptures.

The emergency medical service is operated by a private company. Currently, no fire apparatus is equipped with automated external defibrillators (AED); however, they have been ordered for all fire apparatus.

**Training.** The fire department provides all new fire fighters with the basic 12-week recruit training conducted at the city's Drill School to become certified to the National Fire Protection Association (NFPA) Fire Fighter I level. All are State-certified Medical Response Technicians and are certified in CPR, defibrillator, and hazardous materials operations. The department also conducts monthly training. The victim had 10 years of fire fighting experience and was an NFPA-certified Fire Fighter I.

**Preemployment/Preplacement Evaluations.** The department requires a preemployment/preplacement medical evaluation for all new hires, regardless of age. Components of this evaluation for all applicants include

- A complete medical history
- Height, weight, and vital signs
- Physical examination
- Vision test
- Hearing test
- Complete blood count (CBC)
- Blood lipid profile (total cholesterol, HDL cholesterol, triglycerides)
- Blood chemistries (chem 30)
- Urinalysis
- Urine drug test
- Chest X-ray
- Spirometry
- Exercise electrocardiogram

These evaluations are performed by a contract physician hired by the City Civil Service Commission, and the results are given to the Civil Service Commission. Once this evaluation is complete, a decision regarding medical clearance for fire fighting duties is made by the contractor. New hires are also required to complete a physical agility test. This is a timed performance evaluation of typical fire fighting duties. Finally, medical clearance for SCBA use is determined as part of the physical examination.

**Periodic Evaluations.** Medical evaluations are required by this department on a periodic basis (every 3 years). Components of this evaluation for all fire fighters include

- A complete medical history
- Height, weight, and vital signs
- Physical examination
- Audiometry
- Complete blood count (CBC)
- Blood lipid profile (total cholesterol, HDL cholesterol, triglycerides)
- Blood chemistries (chem 30)
- Urinalysis
- Chest X-ray
- Resting or exercise electrocardiogram (depending on risk factors)
- Spirometry
- PPD test

### **DISCUSSION**

In the United States, coronary artery disease (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death.<sup>1</sup> Risk factors for its development include increasing age, male gender, family history of coronary artery disease, smoking, high blood pressure, high blood cholesterol, obesity, physical inactivity, and diabetes.<sup>2</sup> The victim had only four of these risk factors (male gender, family history, history of smoking, and high



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cholesterol). The victim had stopped smoking 4 months before his death. However, 2 to 3 years are required to eliminate the added risk of smoking on coronary artery disease.<sup>3</sup>

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.<sup>4</sup> However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.<sup>5</sup> Heart attacks typically occur with the sudden development of complete blockage (occlusion) in one or more coronary arteries that have not developed a collateral blood supply.<sup>6</sup> This sudden blockage is primarily due to blood clots (thrombosis) forming on the top of atherosclerotic plaques.

Fire fighting activities are strenuous and often require fire fighters to work at near maximal heart rates for long periods. The increase in heart rate has been shown to begin with responding to the initial alarm and persist through the course of fire suppression activities.<sup>7-9</sup> Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.<sup>10-13</sup> The mental and physical stress of responding to the emergency, briskly walking up two flights of stairs in his bunker gear and SCBA, and his presumed underlying atherosclerotic coronary artery disease all contributed to this victim's probable heart attack, cardiac arrest, and sudden cardiac death. The term "probable" is used because autopsy findings and/or blood tests (cardiac isoenzymes) are required to "confirm" a heart attack (myocardial infarction) and neither of these were performed. (If there is a heartbeat, an electrocardiogram [EKG] can also confirm a heart attack.)

This victim did not report prior episodes of angina (heart pain) during physical activity performed on or off the job. But sudden cardiac death is often the first overt manifestation of ischemic heart disease.<sup>14</sup>

Discrepancies existed in the frequency of the Department's medical evaluation and those recommended by the NFPA.<sup>15</sup> For example, the Department conducts medical evaluations only once every 3 years, regardless of age. The NFPA recommends annual medical evaluations (including an interval medical and occupational history, height, weight, and blood pressure) with periodic medical examinations (including an examination of all bodily systems, visual acuity and peripheral vision testing, pulmonary function testing, and laboratory and diagnostic testing if indicated). NFPA recommends these periodic medical examinations occur every 3 years for those fire fighters 29 years old and under, every 2 years for those 30 to 39 years old, and annually for those 40 and above. As part of these periodic medical examinations, NFPA also recommends exercise stress tests beginning at age 40, or age 35 for those fire fighters with risk factors for CAD.<sup>16</sup>

#### **RECOMMENDATIONS AND DISCUSSION**

The following recommendations address health and safety generally. This list includes some preventive measures that have been recommended by other agencies to reduce the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. These recommendations have not been evaluated by NIOSH but represent research presented in the literature or of consensus votes of Technical Committees of the National Fire Protection Association or labor/management groups within the fire service. In addition, they are presented in a logical programmatic order and are not listed in a priority manner.

***Recommendation #1: Fire Fighters should have annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.***



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Guidance regarding the content and scheduling of periodic medical examinations for fire fighters can be found in *NFPA 1582, Standard on Medical Requirements for Fire Fighters*,<sup>15</sup> and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs wellness/fitness initiative.<sup>17</sup> The department is not legally required to follow any of these standards. Nonetheless, we recommend the City and Union **negotiate** the content and frequency to be consistent with the above guidelines.

Specifically, the preemployment/preplacement stress (EKG) tests are not necessary for applicants under the age of 35. While these tests are not harmful, they do represent an unnecessary expense for the department. On the other hand, annual/periodic medical evaluations should be conducted.

In addition to providing guidance on the frequency and content of the medical evaluations, NFPA 1582 provides guidance on medical requirements for persons performing fire fighting tasks. Applying NFPA 1582 involves legal issues, so it should be carried out in a **confidential, nondiscriminatory** manner. Appendix D of NFPA 1582 provides guidance for Fire Department administrators regarding legal considerations in applying the standard.

Applying NFPA 1582 also 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*, addresses these issues in Chapter 8-7.1 and 8-7.2.<sup>18</sup>

The success of medical programs hinges on protecting the affected fire fighter. The department must (1) keep the medical records confidential, (2) provide alternate duty positions for fire fighters in rehabilitation

programs, and (3) if the fire fighter is not medically qualified to return to active fire fighting duties, provide permanent alternate duty positions or other supportive and/or compensated alternatives.

***Recommendation #2: Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by phasing in a mandatory wellness/fitness program for fire fighters.***

NFPA 1500 requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.<sup>18</sup> In 1997, the International Association of Fire Fighters and the International Association of Fire Chiefs joined in a comprehensive *Fire Service Joint Labor Management Wellness/Fitness Initiative* to improve fire fighter quality of life and maintain physical and mental capabilities of fire fighters. Ten fire departments across the United States joined this effort to pool information about their physical fitness programs and to create a practical fire service program. They produced a manual with a video detailing elements of such a program.<sup>17</sup> The Fire Department and the Union should review these materials to identify applicable elements for their department. Other large-city negotiated programs can also be reviewed as potential models.

***Recommendation #3: Perform an autopsy on all on-duty fire fighters whose death may be cardiovascular-related.***

In 1995, the United States Fire Administration (USFA) published the *Firefighter Autopsy Protocol*.<sup>19</sup> This publication hopes to provide “a more thorough documentation of the causes of firefighter deaths for three purposes:

- (1) to advance the analysis of the causes of firefighter deaths to aid in the development of improved



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- firefighter health and safety equipment, procedures, and standards;
- (2) to help determine eligibility for death benefits under the federal government's Public Safety Officer Benefits Program, as well as state and local programs; and
  - (3) to address an increasing interest in the study of deaths that could be related to occupational illnesses among firefighters, both active and retired."

An autopsy was not performed on this fire fighter; therefore, no exact cause of death can be determined.

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**INVESTIGATOR INFORMATION**

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