



## **Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts**

### **SUMMARY**

On April 28, 1999, a 56-year-old male volunteer fire fighter responded to a structural fire in a three-story wood-framed building, where he was actively engaged in fire suppression duties for over 2 ½ hours. Approximately 20 minutes after leaving the fire scene he collapsed in his home. Cardio-pulmonary resuscitation (CPR) was initially administered by the victim's wife, and then by fire fighters trained as emergency medical technicians (EMT). EMTs also connected the victim to a semi-automatic external defibrillator (SAED) and a single shock (defibrillation) was successful in returning a weak peripheral pulse to the victim. Unfortunately, shortly after arrival in the local hospital's emergency department, the victim suffered a second cardiac arrest. Fifteen minutes of CPR and advanced life support (ALS) measures were again successful at reviving the victim, but he remained unconscious and in critical condition. He was flown to a regional tertiary hospital, where 4 days of intensive measures were unsuccessful, and he was pronounced dead on May 2, 1999. The death certificate, completed by the treating physician (Certifying Physician), listed "coronary thrombosis" as the immediate cause of death, due to "ventricular tachycardia," with "hypertension" being an "other significant condition contributing to [the] 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

- *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.*
- *Fire fighters should be provided with medical evaluations to wear self-contained breathing apparatus (SCBA).*
- *All personnel entering a potentially hazardous atmosphere should wear an SCBA.*
- *Carboxyhemoglobin levels should be tested on symptomatic or unresponsive fire fighters exposed to smoke.*
- *Autopsies should be performed on all on-duty fire fighters whose death may be cardiovascular-related.*
- *Fire fighters experiencing signs and symptoms of heart attacks while on duty*

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:

<http://www.cdc.gov/niosh/firehome.html>

or call toll free 1-800-35-NIOSH



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

- should report them to their supervisor/ incident commander for prompt medical evaluation.*
  - Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*
- Emergency medical services—ambulance report;
  - Hospital emergency department records of the resuscitation effort;
  - Death certificate of the deceased;
  - FD policies, training, and operating procedures.

NIOSH personnel also visited the fire scene and contacted the local International Association of Fire Fighters (IAFF) President.

#### **INTRODUCTION & METHODS**

On April 28, 1999, a 56-year-old male Fire Fighter lost consciousness when he returned to his home after responding to a fire. Despite immediate CPR administered by the victim's wife and EMTs, ALS administered by the emergency department personnel, and treatment at a tertiary care hospital, the victim died on May 2, 1999. NIOSH was notified of this fatality on May 3, 1999, by the United States Fire Administration. On May 15, 1999, NIOSH contacted the affected fire department to initiate the investigation. On June 23, 1999, a Senior Medical Epidemiologist from the NIOSH Fire Fighter Fatality Investigation Team and a NIOSH Industrial Hygienist traveled to Massachusetts to conduct an on-site investigation of the incident.

During the investigation NIOSH personnel met with and interviewed the

- State Fire Marshal
- Deputy Fire Chief
- Victim's spouse
- Victim's personal physician

During the site visit NIOSH personnel reviewed

- Existing fire department (FD) investigative records, including incident reports, co-worker statements, and dispatch records;
- Past medical records of the deceased maintained by the victim's personal physician;

#### **INVESTIGATIVE RESULTS**

*Incident Response.* On April 28, 1999, at 1143 hours, the FD received a telephone report of a fire in a restaurant kitchen hood. The restaurant and kitchen were located in the basement of a 150-year-old three-story wood-frame building. Engine 4, Ladder 1, Rescue 1, and two fire officers were dispatched to the scene, located approximately 1 mile from the fire station.

The responding units began to arrive on scene at 1147 hours. The victim, a volunteer Captain, arrived by car at essentially the same time as the fire apparatus. Heavy smoke and fire was visible at the roof exhaust hood (ventilator) above the kitchen. Further investigation revealed heavy smoke and heat on the second and third floors due to fire extension through walls to the upper floors, which were used for employee housing. One fire fighter crew was assigned to suppress the fire in the kitchen's exhaust hood and to open (ventilate) the kitchen's roof. Other fire fighters encountered heavy smoke and high heat while attempting an interior attack on the second and third floors. Another crew opened the main building's roof and found a second, or false, roof. After both roofs were opened, attack crews were able to enter the second and third floors where they encountered a heavy fuel load and extension of fire into the many voids of the wood-frame building.



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

The victim was wearing full turn-out gear without self-contained breathing apparatus (SBCA). At approximately 1200 hours, the victim entered the first floor of the building in an attempt to access and inspect the upper floors, but heavy smoke turned him back. He came out of the building and asked another fire fighter (who had donned an SCBA) to go upstairs. It appears that the victim remained outside the building during the remainder of the fire. Outside the building the victim was responsible for (1) laying, pulling, and organizing supply lines (e.g., the victim told a fellow fire fighter that he had pulled approximately 200 feet of 3-inch supply line from a hydrant to the ladder truck); (2) laying, pulling, and organizing attack lines; and (3) changing SCBA bottles. He was on scene approximately 2 hours and 45 minutes.

At the scene, the victim reported no symptoms such as chest pain or palpitations; however, he appeared “tired” to other fire fighters and, on at least one occasion, short of breath. He was observed at one point breathing oxygen from one of the rescue squad’s oxygen tanks. At approximately 1345 hours, the victim went to a rescue unit to have a small piece of glass removed from his hand. After the glass was removed, the EMT noted his fatigued and ashen appearance and suggested that he continue to rest. He dismissed the EMT’s suggestion and proceeded to assist in the fire suppression efforts. At approximately 1430 hours, the EMT saw the victim leaning on a truck and then walking away from the fire scene. As he was leaving, one fire fighter noted him saying, “I’m too old for this.”

At approximately 1435 hours, the victim arrived at home. His wife noted his fatigued condition and soot-covered appearance. He complained of being tired and having indigestion. He took some Alka Selzer and headed for the bathroom. At about 1454 hours, the victim’s wife heard a loud thud, and hurrying into the bathroom, found her husband collapsed in the

shower. After trying to awaken him, she dialed 911 and immediately began CPR. The police unit and the fire department rescue crew (Rescue 3 staffed with at least one EMT certified in the use of the SAED) arrived at the victim’s home roughly at the same time (1456 hours). Emergency response personnel found him to be unresponsive, cyanotic, without a pulse or respirations, and took over the CPR efforts. A second fire department rescue crew (Rescue 1) arrived with three EMTs certified in the use of the SAED (EMT-D). They attached the electrodes of an SAED while CPR continued. After approximately 1 minute, CPR was halted while the SAED analyzed the victim’s heart rhythm. The unit suggested a problem with the electrodes, and emergency response personnel shaved the victim’s chest in the areas under the electrode pads. After analyzing the victim’s rhythm for a second time, a shockable heart rhythm was reported, and a shock was delivered. The SAED responded with “check pulse”; however, no pulse was found upon palpation. CPR was continued for 1 minute, followed by SAED analysis. The SAED responded with “check pulse,” and a weak pulse was palpated. EMTs then placed the victim on a backboard for transport to the hospital (1502 hours). Throughout this resuscitation effort, EMTs provided 100 percent oxygen via a bag-valve-mask (Ambu-bag).

The victim arrived at the local hospital at 1505. On arrival he was unresponsive, with no pulse or respirations. CPR was reinitiated as emergency department personnel intubated the victim, established intravenous (IV) access, administered IV medications, and delivered shocks consistent with ALS protocols. Fourteen minutes of CPR and ALS measures were successful at reviving the victim, but he remained in critical condition due to extremely low blood pressure (cardiogenic shock). An electrocardiogram (EKG) was taken at this time and was consistent with an acute inferior myocardial infarction (heart attack). Medications (pressors)



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

were used to raise his blood pressure, while arrangements were made to transport him to a regional tertiary hospital. At the referral hospital, the victim was reportedly taken to the cardiac catheterization laboratory to palliate end-stage cardiogenic shock and to treat a thrombotic (blood clot) in his coronary artery. Despite 4 days of intensive measures, the victim never regained consciousness and was pronounced dead on May 2, 1999.

*Medical Findings.* The death certificate was completed by the treating physician in the tertiary hospital, who listed “coronary thrombosis” as the immediate cause of death, due to “ventricular tachycardia,” with “hypertension” being an “other significant condition contributing to [the] death.” Medical records indicated that the victim had four known risk factors (advancing age, male gender, cigarette smoking, and hypertension) for coronary artery disease (CAD). Family members reported the victim did not exercise regularly, but never complained of chest pain or other symptoms suggestive of angina (heart pain) at home, during leisure activities, while performing his job as a heating/air-conditioning contractor, or while performing fire suppression duties. The victim had not participated in any fire department responses during the 24 hours prior to this incident.

During the morning of the structural fire, the victim had not complained of any symptoms suggestive of angina. During the fire suppression effort, however, several fire fighters noted he looked tired, but this was true for almost all of the fire fighters participating in the suppression effort. Although the fire was under control, the victim left the fire scene prior to other fire department personnel being released. He did not notify other fire fighters or the Incident Commander that he was leaving. This was not the standard practice for the Fire Department, nor characteristic of the victim, who typically was the

last fire fighter to leave the fire scene. This may have been the first indication that his health was in jeopardy.

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

At the time of the NIOSH investigation, the fire department was comprised of 50 uniformed personnel who serve a population of 8,000 permanent residents, as well as 42,000 part-time summer residents in a geographic area of 45 square miles. It is a combination paid/volunteer department, with 20 paid uniformed personnel and 30 volunteer fire fighters who are paid \$14 for each response. The department operates four fire stations: three “call” and one permanently staffed. Paid staff work two 10-hour and two 14-hour shifts according to the following tour: Day 1 & 2, 0800-1800; Day 3 & 4, 1800-0800; Day 5, 6, 7, off duty. Four work groups are each staffed by an officer and three fire fighters. Occasionally these staffing levels are lower due to vacation, sick days, and training.

An engine and ladder apparatus respond to each structural fire. One fire fighter officer and one fire fighter operator staff the engine; one fire fighter operator staffs the ladder; the fourth fire fighter remains in the fire station to man the dispatch unit. All volunteers are paged when the engine and ladder are dispatched and they typically arrive at the fire scene at the same time, or just prior to the fire suppression vehicles. In 1998, the department responded to 1,100 fire-related calls.

The emergency medical service (EMS) is also run by the fire department with 35 fire fighters trained as EMT-D. EMS equipment includes three ambulances and four motor-medics (EMT on a motor-cycle equipped with a trauma kit, oxygen, defibrillator, and cervical spine management equipment.) In 1998, the department responded to 1,217 EMS calls.



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

---

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

Training. Due to the highly competitive nature of the paid positions, almost all new hires are NFPA fire fighter level I or II certified. In addition, all are first responders and EMT-D. The State does not require the fire fighters to maintain their NFPA fire fighter certification; however, they do require biannual re-certification of their EMT status. Volunteers are not required to have prior fire fighting/EMT experience or certification. Although not a certified EMT or NFPA certified fire fighter, the victim had 35 years of fire fighting experience.

Pre-employment/Pre-placement Evaluations. As required by State Law since 1996, the department requires a pre-employment/pre-placement medical evaluation for all new paid and volunteer positions, regardless of age. Mandatory components of this evaluation for all applicants include

- A complete medical history (to include an occupational history with significant past exposures and training and experience with personal protection equipment);
- Height, weight, and vital signs;
- Physical examination (of the skin, ears, eyes, nose, throat, mouth, mental status evaluation, and the following systems: cardiovascular, respiratory, gastrointestinal, genitorurinary, musculoskeletal, neurologic, endocrine, and metabolic);
- Vision test (acuity and peripheral vision);
- Hearing test (audiometry);
- Pulmonary function testing;
- Other diagnostic tests where indicated.

Optional components of this evaluation include a

- Review of tetanus and hepatitis B immunization status
- Ppd test (skin test for tuberculosis)
- Five-panel drug test
- Urine dipstick

- Chest x-ray
- Electrocardiogram
- Complete blood count
- Chemistry panel (20 items)

These evaluations are performed by a contract physician retained by the Department. The physician then makes a decision regarding medical clearance for fire fighting duties and sends the clearance report to the Department. As required by State Law since 1996, all new paid and volunteer positions are also required to complete a physical ability test (PAT). This is a timed performance evaluation of typical fire fighting duties conducted after the applicant has received medical clearance. Medical clearance for SCBA use is not required for either paid or volunteer fire fighters.

Periodic Evaluations. No annual/periodic medical evaluations are required by this Department. For employees hired after 1996, the State requires a biannual PAT. Prior to taking the PAT, the State recommends, but does not require, that each individual complete a “physical activity readiness questionnaire.” This self-administered questionnaire, composed of seven questions, is intended to identify “the small number of adults for whom physical activity might be inappropriate and those who should have medical clearance prior to exercise and testing.” The department does not have any members who have reached this 2-year re-testing period. The components of this Department’s medical screening prior to the periodic PAT is currently under discussion. Although the manned station has exercise (strength and aerobic) equipment purchased/donated by the fire fighters themselves, there is no voluntary or required fitness/wellness program. SCBA performance tests are conducted on an annual basis, although no periodic specific medical clearance for SCBA use is required.



---

*Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

**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 four of these risk factors (advancing age, male gender, cigarette smoking and hypertension). Although an autopsy was not performed to confirm the presence of coronary artery atherosclerosis, it was probably present in this individual based on his CAD risk factors and the electrocardiogram in the hospital's emergency department which was consistent with a heart attack.

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.<sup>3</sup> However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.<sup>4</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>5</sup> This sudden blockage is primarily due to blood clots (thrombosis) forming on the top of atherosclerotic plaques. The death certificate listed coronary thrombosis, which was identified during the emergency cardiac catheterization, as the cause of death.

Firefighting 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>6-8</sup> Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.<sup>9-12</sup> The physically demanding job of laying, pulling, and organizing charged supply and attack hoses while wearing bunker gear, the mental stress

of responding to the emergency, and his likely underlying atherosclerotic coronary artery disease all contributed to this victim's heart attack, cardiac arrest, cardiogenic shock, and subsequent death.

This victim did not report prior episodes of angina (heart pain) during physical activity performed on or off the job. Unfortunately, sudden cardiac death is often the first overt manifestation of ischemic heart disease.<sup>13</sup> This fatality occurred despite very prompt and appropriate CPR and ALS efforts.

The fire department is currently following the State's required pre-employment/pre-placement medical evaluation. There are discrepancies between State requirements for the frequency and content of this evaluation, and the medical evaluation recommended by the NFPA.<sup>14</sup> The most significant discrepancy is found in the annual/periodic evaluation. For example, the State only requires a self-completed questionnaire to identify individuals who may need further medical evaluation prior to initiating a physical ability test. NFPA, on the other hand, recommends that a physician conduct annual medical evaluations on all fire fighters regardless of age. These evaluations consist of (1) an update of the fire fighter's medical history (including any significant changes, a brief review of symptoms, and a report on any significant job-related exposures experienced during the past year), (2) height and weight, (3) visual acuity, (4) blood pressure, and (5) any additional testing depending on the fire fighter's medical condition.

NFPA also recommends a more thorough evaluation, including a medical examination be conducted on a periodic basis depending on the age of the fire fighter. For individuals < 30 years of age—every 3 years; for those 30-39—every 2 years; for those 40 and over—every year. The recommended content of this evaluation includes (1) an updated medical and interval history, (2) complete physical examination, (3) vision testing, (4) audiometry, (5) pulmonary



---

*Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

function testing, (6) complete blood count, (7) urinalysis, (8) biochemical (blood) test battery, and (9) exercise stress (treadmill) tests. The NFPA recommends stress tests at least every 2 years for those 35 years old and above with known CAD risk factors, and 40 years old and above for those without CAD risk factors. This exercise stress testing procedure has errors both in over-diagnosis and in under-diagnosis, although newer techniques, including the use of thallium administration or additional monitoring, can improve the accuracy of the procedure.<sup>15</sup> It is thus possible that asymptomatic fire fighters could have coronary artery disease detected before an event such as a myocardial infarction occurred.<sup>16</sup> If a treadmill test had been performed on this fire fighter, his underlying CAD may have been identified and he would then probably have been directed toward further evaluation and treatment.

#### **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 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.***

The Department is currently following the mandatory components of the State-required pre-employment/pre-placement examination. These State requirements are consistent with those recommended by NFPA. On the other hand, the Department is not conducting any annual/periodic medical evaluations as recommended by NFPA. 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>14</sup> and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs wellness/fitness initiative.<sup>17</sup> We have purchased and enclosed a single copy of NFPA 1582 for your department. The department is not legally required to follow any of these standards. Nonetheless, we recommend the City and Union **negotiate** the content and frequency of the annual medical evaluation to be consistent with the NFPA guidelines.

In addition to providing guidance on the frequency and content of the medical evaluation, 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>



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

---

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

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. These legal and economic repercussions may be particularly difficult for small, combination paid/volunteer fire departments, such as the one involved in this incident, and could negatively impact the ability to recruit and retain needed volunteers.

Another burden disproportionately placed on small and/or geographically isolated combination or volunteer departments, is the State's preemployment and biannual PAT. Although important for assessing each fire fighter's fitness for duty, the regulation may adversely affect recruitment and retention of volunteers. For example, volunteers may encounter uncompensated expenses for travel and missing a day of work at their regular job. States requiring the PAT should consider ways of reducing this burden on volunteer fire fighters. One way that this might be accomplished would be by establishing a mobile test unit that could travel to small volunteer (or combination) departments, where the PAT could be administered at a time and location which would minimize the uncompensated expenses currently incurred by volunteers.

***Recommendation #2: Fire fighters should be provided with medical evaluations to determine their fitness to wear self-contained breathing apparatus (SCBA).***

In 1997, OSHA published its revised respiratory protection standard.<sup>19</sup> This standard, among other things, requires that a medical evaluation of fire fighters wearing SCBA be performed by a physician or other licensed health care professional. This

evaluation could consist of a screening questionnaire (enclosed) to ascertain if additional medical evaluations or a medical examination is warranted. Because Massachusetts does not have an Occupational Safety and Health Administration (OSHA)- approved state plan, its state and municipal employees, such as fire fighters, are not covered under the Occupational Safety and Health Act. Therefore, State, County, or City fire departments in Massachusetts are NOT required to comply with OSHA standards. Nonetheless, we recommend voluntary compliance with the respiratory protection standard to ensure that fire fighters can safely wear SCBA.

***Recommendation #3: All personnel entering a potentially hazardous atmosphere should wear SCBA.***

SCBA must be worn when a fire fighter enters an area that is considered immediately dangerous to life or health (IDLH) or potentially IDLH or where the composition of the atmosphere is unknown. Smoke, vapor, or fumes from a fire or hazardous material incident may contain many toxic components. Some of these components will have immediate effects on the unprotected fire fighter (e.g., carbon monoxide poisoning), while others (e.g., smoke particulates) have cumulative effects, resulting from years of exposure. Since the victim did enter the interior of the building, he was at least exposed to light smoke conditions and should have been wearing his SCBA.

***Recommendation #4: Carboxyhemoglobin levels should be tested on symptomatic or unresponsive fire fighters exposed to smoke.***

Unfortunately, a carboxyhemoglobin level was not determined at the hospital; this would have provided a good assessment of the victim's exposure to carbon monoxide. It is unlikely, however, that his carboxyhemoglobin level would have been elevated



## Fatality Assessment and Control Evaluation Investigative Report #99F-19

### *Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

since he only had a brief exposure to smoke as he entered the building, some 3 hours before arriving at the hospital. Furthermore, knowledge of his carboxyhemoglobin level would not have affected his treatment or outcome since he was already receiving oxygen. Nonetheless, to assist the investigation of fire-related deaths, since even a modest carbon monoxide exposure, in the presence of other cardiac stressors and risk factors, could contribute to a heart attack, we recommend performing carboxyhemoglobin levels even if carbon monoxide poisoning per se is unlikely.

#### ***Recommendation #5: Autopsies should be performed on all on-duty fire fighter fatalities.***

In 1995, the United States Fire Administration (USFA) published the Firefighter Autopsy Protocol.<sup>20</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 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.”

#### ***Recommendation #6: Fire fighters experiencing signs and symptoms of heart attacks while on duty should report them to their supervisor/ incident commander for prompt medical evaluation.***

All fire fighters in this department are trained and certified as first responders. First responder training includes taking vital signs and recognizing signs and symptoms of heart attacks. Recognizing these signs and symptoms in oneself is often difficult, particularly if the pain resembles heartburn or indigestion. It is possible that if this individual had notified his supervisor or incident commander about his symptoms and/or sought medical care (e.g., a visit to the emergency department) prior to his collapse, appropriate intervention may have prevented his death at this time.

#### ***Recommendation #7: Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.***

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 cities’ negotiated programs can also be reviewed as potential models.

#### **REFERENCES**

1. Fauci AS, Braunwald E, Isselbacher KJ, et al. [1998]. Harrison’s principles of internal medicine.



Fatality Assessment and Control Evaluation  
Investigative Report #99F-19

---

*Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire Suppression Duties - Massachusetts*

- 14<sup>th</sup> ed. New York, NY: McGraw-Hill, pp.222-225.
2. American Heart Association (AHA) [1998]. AHA scientific position, risk factors for coronary artery disease. Dallas, TX.
3. Fauci AS, Braunwald E, Isselbacher KJ, et al. [1998]. Harrison's principles of internal medicine. 14<sup>th</sup> ed. New York, NY: McGraw-Hill, p.1348.
4. Shah PK [1997]. Plaque disruption and coronary thrombosis: new insight into pathogenesis and prevention. *Clin Cardiol* 20 (11 Suppl2): II-38-44.
5. Fuster V, Badimon JJ, Badimon JH [1992]. The pathogenesis of coronary artery disease and the acute coronary syndromes. *N Eng J Med* 326:242-250.
6. Barnard RJ, Duncan HW [1975]. Heart rate and ECG responses of fire fighters. *J Occup Med* 17:247-250.
7. Manning JE, Griggs TR [1983]. Heart rate in fire fighters using light and heavy breathing equipment: simulated near maximal exertion in response to multiple work load conditions. *J Occup Med* 25:215-218.
8. Lemon PW, Hermiston RT [1977]. The human energy cost of fire fighting. *J Occup Med* 19:558-562.
9. Willich SN, Lewis M, Lowel H, et al. [1993]. Physical exertion as a trigger of acute myocardial infarction. *N Eng J Med* 329:1684-1690.
10. Mittleman MA, Maclure M, Tofler GH, et al. [1993]. Triggering of acute myocardial infarction by heavy physical exertion. *N Eng J Med* 329:1677-1683.
11. Siscovick DS, Weiss NS, Fletcher RH, Lasky T [1984]. The incidence of primary cardiac arrest during vigorous exercise. *N Eng J Med* 311:874-877.
12. Tofler GH, Muller JE, Stone PH, et al. [1992]. Modifiers of timing and possible triggers of acute myocardial infarction in the Thrombolysis in Myocardial Infarction Phase II (TIMI II) Study Group. *J Am Coll Cardiol* 20:1049-1055.
13. Fauci AS, Braunwald E, Isselbacher KJ, et al. [1998]. Harrison's principles of internal medicine. 14<sup>th</sup> ed. New York, NY: McGraw-Hill, p.1366.
14. National Fire Protection Association [1997]. NFPA 1582: standard on medical requirements for fire fighters. Quincy, MA: National Fire Protection Association.
15. Michaelides AP, Psomadaki ZD, Dilaveris PE, et al. [1999]. Improved detection of coronary artery disease by exercise electrocardiography with the use of right precordial leads. *New Eng J Med* 340:340-345.
16. Gianrossi R, Detrano R, Mulvihill D, et al. [1989]. Exercise-induced ST depression in the diagnosis of coronary artery disease: a meta-analysis. *Circulation* 57:64-70.
17. International Association of Fire Fighters [1997]. The fire service joint labor management wellness/fitness initiative. Washington, DC: International Association of Fire Fighters, Department of Occupational Health and Safety.
18. National Fire Protection Association [1997]. NFPA 1500: standard on fire department occupational safety and health program. Quincy, MA: National Fire Protection Association.



Fatality Assessment and Control Evaluation  
Investigative Report #99F-19

---

*Fire Fighter Suffers a Fatal Heart Attack After Being Engaged in Extensive Fire  
Suppression Duties - Massachusetts*

19. 29 CFR 1910.134. Code of Federal Regulations. Occupational Safety and Health Administration: Respiratory Protection. Washington, DC: National Archives and Records Administration, Office of the Federal Register.

20. United States Fire Administration (USFA) [1995]. Firefighter Autopsy Protocol. Emmitsburg, MD: Federal Emergency Management Agency, USFA, Publication No. FA-156.

**INVESTIGATOR INFORMATION**

This investigation was conducted by and the report written by Thomas Hales, MD, MPH, Senior Medical Epidemiologist, and David Sylvain, MS, CIH, Regional Industrial Hygienist. Dr. Hales is with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component, located in Cincinnati, Ohio. Mr. Sylvain is with the NIOSH Health Hazard Evaluation Program located in the New England Field Office.