



## Fire Fighter Suffers Fatal Heart Attack - Pennsylvania

### SUMMARY

On January 16, 1999, a 55-year-old male career Fire Fighter/Ladder Driver (the victim) and engine crew were dispatched at 1519 hours to a structural fire at a local church. Upon his arrival at the scene at 1530 hours, the victim exited the ladder truck, walked around the rear of the truck to the passenger's side, leaned against the vehicle, and began gasping for breath. An Officer at the scene noted that the victim looked ashen and asked how he was feeling. The victim responded that he felt dizzy and weak. The Officer notified paramedics in an ambulance on the scene that the victim required assistance, and at 1533 hours, the victim received oxygen via bag valve mask and peripheral intravenous (IV) medications for severe respiratory distress. The victim, who did not lose consciousness, was transferred at 1540 hours via ambulance to a local hospital. He was admitted for 5 days, and thereafter, discharged home. He did not return to work after this incident. After a succession of health events, including hospital re-admissions, the victim died June 9, 1999. The death certificate listed the immediate cause of death as an acute myocardial infarction (heart attack). No underlying or contributing conditions were listed on the death certificate. An autopsy was not performed.

Other agencies have proposed a three-pronged strategy for reducing the risk of heart attacks 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. An evaluation of this Department suggests the following recommendations for his surviving colleagues:

- *Fire Fighters should have preemployment and 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 the fire fighters.*
- *Provide adequate fire fighter staffing to ensure safe operating conditions.*

### INTRODUCTION & METHODS

On January 16, 1999, a 55-year-old male career Fire Fighter/Ladder Driver (the victim) and engine crew were dispatched at 1519 hours to a structural fire at a local church. The victim arrived at the fire scene, parked the aerial truck, exited the truck, and informed an Officer on the scene that he was not

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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feeling well. The Officer noted that he looked ashen and was gasping for breath. The Officer notified paramedics on standby at the scene. At 1533 hours, paramedics initiated treatment for the victim's severe respiratory distress. At 1540 hours, the victim was transferred to a local hospital where he was admitted into a medical intensive care unit. After an approximate 5-day hospital stay, the victim was discharged home. He did not return to work after this incident. On June 6, 1999, while hospitalized, the victim died of an acute myocardial infarction.

The National Institute for Occupational Safety and Health (NIOSH) was notified of this fatality through the United States Fire Administration's Firefighters Memorial. On October 18, 1999, NIOSH contacted the fire department to initiate the investigation. On December 13, 1999, a Nurse Epidemiologist from the NIOSH Fire Fighter Fatality Investigation and Prevention Team conducted an on-site investigation.

During the site visit, the NIOSH investigator met with and/or interviewed

- The Fire Chief
- The Local Union President/Captain of the victim's shift
- Fire Fighters from the victim's shift
- The Municipality Manager
- The Director of Operations for the Occupational Medicine Mobile Unit contracted by the Municipality for medical screenings

During the site visit NIOSH personnel also reviewed

- The Fire Inspector's incident report
- Fire Department personnel records
- Fire Department dispatch records
- Fire Department policies, training, and operating procedures
- Death certificate
- National Climatic Data Center weather report for incident date

At the time of the investigation, NIOSH did not have access to any hospital or personal physician medical records. Without this documentation, NIOSH cannot determine that the victim sustained a heart attack at the time of this incident or that the victim's fatal heart attack on June 9, 1999, was related to the structural fire occurring on January 16, 1999.

### **INVESTIGATIVE RESULTS**

*Incident.* On January 16, 1999, at 1519 hours, the Department was notified by county dispatch of a structural fire discovered by a police officer during his patrol. The dispatch came during the Department's cross-shift, so those working the 7 a.m.-to-4 p.m. shift, as well as the victim's shift, working 4 p.m. to 7 a.m., responded. Department records noted that the victim had just arrived after a 5-day scheduled absence, and this was the first call for his shift. An engine and aerial ladder were dispatched from this Department. (Because the Department's engine at its second station was mechanically out of service, mutual aid from a neighboring community was also dispatched.) Upon his arrival at the scene at 1530 hours, the victim parked and exited the aerial ladder truck, walked around the rear of the truck to the passenger's side, leaned against the vehicle, and began gasping for breath. An Officer on the scene noted the victim's ashen pallor and respiratory distress. He asked the victim how he was feeling, and the victim stated that he felt dizzy and weak. Colleagues present noted that the victim was never in close proximity to the burning structure, nor did the burning structure emit much smoke.

At 1533 hours, an ambulance crew on the scene began administering oxygen via bag valve mask at 15 liters/minute. A peripheral IV was started and IV medications to facilitate respiration were administered twice during transport to a local hospital. The victim did not lose consciousness during transport



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and reported some respiratory relief from the administration of IV medications. At 1540 hours, the ambulance arrived at the local hospital, where the victim was admitted into the medical intensive care unit for approximately 5 days.

The victim did not return to work after this incident. Medical records of this hospital stay, or subsequent hospitalizations, and those of his personal physicians were not available to NIOSH at the time of this investigation. He was again hospitalized in May 1999, and he remained hospitalized until his death on June 9, 1999. The death certificate listed the cause of death as an acute myocardial infarction.

*Medical Findings.* The death certificate completed by the pronouncing and certifying physician listed the victim's immediate cause of death on June 9, 1999, as an acute myocardial infarction. No underlying or contributory causes were listed. An autopsy was not performed.

The victim's last Department periodic medical screening occurred in September 1998. Pulmonary function testing was performed by the Municipality's contracted occupational medicine mobile unit. Respiratory clearance was "pending" a complete physical examination including electrocardiogram and a chest X-ray performed by his private physician before a determination of the clearance would be provided. In 1997, he was cleared for respirator use for 1 year only and instructed that he must stop smoking.

Colleagues reported that the victim was a very heavy smoker for decades, and he was often short of breath. The victim did not exercise regularly but was not described as obese. Colleagues said that he had high blood pressure which required medication.

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

At the time of the NIOSH investigation, the Fire Department consisted of 24 full-time and five part-time uniformed personnel and served a population of 17,000 residents in a geographic area of 8 square miles. Of the full-time Department members, 19 are publicly-appointed civil servants, and five are considered active reserve. Those on active reserve status are covered by Union contracts, but are not Union members. When hired, they do not receive preemployment/preplacement physicals. The Department has two fire stations, where fire fighters work two consecutive day shifts from 7 a.m. to 4 p.m., followed by two consecutive night shifts from 4 p.m. to 7 a.m., followed by 3 days off duty. This schedule also allows for additional flexible time off with the use of vacation days and a type of accumulated city time-off comparable to Kelly Days.

In 1998, the last complete year the victim worked, the Department responded to 444 calls; 37% were structural fires; 26%, motor vehicle crashes; 9%, investigative/unknown situations; 8%, carbon monoxide alarms; and 20%, "other" (including such incidents as car and brush fires, gas leaks and chemical spills). In September 1999, the Department became certified as First Responders for emergency medical services. (At the time of the victim's service, the Department did not provide this service.) The number of responses is anticipated to significantly increase with this added responsibility as indicated by 1999 fire record system activity reports. At the time of NIOSH's investigation, 12 fire fighters had been certified as emergency medical technicians and six were American Red Cross-certified First Responders.

*Preemployment/Preplacement Evaluations.* The Department requires a preemployment/preplacement medical evaluation for all new hires regardless of age if they are publicly-appointed civil servants. Those



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hired on active reserve status do not receive a preemployment/preplacement medical evaluation. It was difficult to determine the components of this examination since no new civil servant hires have occurred since 1996. However, according to the Municipality, the contracted occupational medicine and rehabilitation center will now include the following components recommended by the National Fire Protection Association (NFPA) 1582 Standard for Fire Fighters:

- A complete medical history
- Height, weight, and vital signs
- Physical examination
- Complete blood count (CBC)
- Blood lipid profile (total cholesterol, HDL cholesterol, triglycerides)
- Urinalysis
- Urine drug test
- Spirometry
- Resting EKG
- Chest X-ray
- Vision test
- Hearing test;
- Fitness Test - Aerobic
- Fitness Test - Strength

Periodic Evaluations. Since 1997, annual periodic medical evaluations have been conducted by an occupational medicine mobile unit contracted by the Municipality for every Department member. The evaluations performed have varied slightly, but have consisted of

- History
- Physical examination, including vital signs
- Spirometry
- Resting electrocardiogram (EKG) which, if normal and no symptoms occur, will not be repeated until age 40
- Vision testing
- Hearing testing

The mobile unit Director of Operations indicated that any abnormalities detected during

these evaluations must be followed up by the fire fighter's medical specialist or private physician within 1 month, and results must be provided to the occupational physician of the mobile unit for determination of fitness-for-duty. The Director also suggested the Department include baseline complete blood counts and cholesterol/triglyceride levels testing, but these were not being provided at the time of this investigation.

The two stations do not have exercise equipment, and currently no fitness/wellness program exists. The stations are very small, and no space is available for equipment. In one station, due to vacation, training, or sickness, scheduling can often result in a single fire fighter manning the day shift. This person may be toned out independently to respond to any type of hazardous situation, and fire fighters recounted incidents in which they had responded alone to structural fires, sometimes involving civilians, before assistance arrived. Concerns regarding potential dangers of solitary response to hazardous situations were voiced by the fire fighters.

Training. All new hires are provided 88 hours of basic fire fighter essentials. This is required before attending the Pennsylvania State Fire Academy. After completing 5 days at the State Academy, the fire fighter is certified as NFPA Fire Fighter I. Additionally, 20 hours of in-house fire fighter training are provided annually. Emergency medical technician certification which consists of 5 1/2 months of training, will be required for all those hired after 1988. The victim had 28 years of fire fighting experience and was Fire Fighter I and Driver Operator certified.

### **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



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factors for its development include increasing age (age greater than 45 years), 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 several known risk factors including age greater than 45 years, male gender, smoking, high blood pressure, and lack of conditioned physical activity. Documented attempts were made by the Department, including threat of dismissal, to motivate the victim to improve his health. The victim indicated that he would retire as soon as he was eligible, which was just a few months after his death.

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.

Blood clots, or thrombus formation, in coronary arteries are initiated by disruption of atherosclerotic plaques. Certain characteristics of the plaques (size, composition of the cap and core, presence of a local inflammatory process) predispose the plaque to disruption.<sup>4</sup> Disruption then occurs from biomechanical and hemodynamic forces, such as increased blood pressure, increased heart rate, increased catecholamines, and shear forces, which occur during heavy exercise.<sup>6,7</sup> 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>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> Although this fire fighter was responding to an alarm, and arrived at the fire scene, he did not engage in fire suppression activities during this incident.

#### **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 in-the-line- of-duty sudden cardiac death 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 NFPA or labor/management groups within the fire service. And although NIOSH cannot conclude that this Fire Fighter suffered a heart attack at the time of this investigated incident or that his fatal heart attack was related to this incident, his surviving colleagues could benefit from the following recommendations.

***Recommendation #1: Fire Fighters should have preemployment and 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 intends to follow a mandatory preemployment/preplacement examination, but we encourage this examination to include all new hires and not just civil servants. Baseline health assessments are recommended for anyone engaging in this physically and mentally demanding occupation. Additionally, the Municipality which provides annual medical evaluations for each fire fighter should consult with the Department and its contracted occupational medicine mobile unit to make these evaluations more consistent with NFPA recommendations.



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The Municipality requested and was provided a current copy of NFPA's 1582, Medical Requirements for Fire Fighters, to enable them to match NFPA recommendations.<sup>13</sup>

***Recommendation #2: Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by phasing in a mandatory wellness/fitness program negotiated between the Fire Department and the Municipality.***

Currently, the Department has no wellness/fitness program in place. The two stations are very small and even the provision of exercise equipment is implausible in the current setting. However, the fire fighters and the Municipality both expressed a desire for implementation of this type of program. In 1997, the International Association of Fire Fighters and the International Association of Fire Chiefs joined in a comprehensive Fire Service Joint Labor and Management Wellness/Fitness Initiative to improve fire fighter quality of life and maintain physical and mental capabilities of fire fighters.<sup>14</sup>

***Recommendation #3: Provide adequate fire fighter staffing to ensure safe operating conditions.***

Based on interviews conducted during this investigation, it was not uncommon for the Department's second station to be staffed by only one fire fighter during a day shift. We recommend increasing the number of fire fighters assigned to this station during these days, hiring fire fighters to act as "floaters" to fill positions vacated by fire fighters who are sick, on vacation, or participating in training, or staggering vacation days in conjunction with hiring floating fire fighters. The basis for this recommendation is improvement of worker safety while fighting fires or responding to unknown emergency medical situations in their new role as First Responders.

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**INVESTIGATOR INFORMATION**

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