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NIOSH
Fire Fighter Fatality Investigation and Prevention Program

Death in the line of duty...

A summary of a NIOSH fire fighter fatality investigation *October 2008*

Fire Fighter-Emergency Medical Technician Suffers Sudden Cardiac Death During Overhaul – New York

SUMMARY

On February 19, 2007, a 44-year-old male career Fire Fighter-Emergency Medical Technician (FF-EMT) started his shift at 0800 hours. At 1642 hours, he responded to a fire in a high rise apartment building. When the FF-EMT arrived at the fire scene, he was assigned to perform a search for fire victims on the 6th floor. In full turnout gear and self-contained breathing apparatus (SCBA), he performed two walkthroughs looking for spot fires and conducting overhaul activities. The FF-EMT was about to make the third walkthrough when he commented to a crewmember that, "the stairs were a killer." He then turned around, took a few steps, and collapsed. The crew member thought the FF-EMT had tripped on hoselines and tried to assist him in getting up. When the FF-EMT did not respond, nearby crew members were alerted. Incident Command was notified. Initial crewmember assessment revealed the FF-EMT was unresponsive with labored breathing. Shortly thereafter, he lost his pulse and stopped breathing. Cardiopulmonary resuscitation (CPR) was begun, and paramedics (already on scene) responded to the 6th floor to begin treatment. Despite advanced life support treatment, including defibrillation and intubation, administered on-scene, during transport, and in the hospital's Emergency Department, the FF-EMT died. The death certificate (completed by the county coroner) and the autopsy (completed by a pathologist) listed "ischemic heart disease" as the cause of death. The NIOSH investigator concludes the FF-EMT's underlying atherosclerotic coronary artery disease (CAD), coupled with his heavy physical exertion activities at two structure fires triggered his sudden cardiac death.

The NIOSH investigator offers the following recommendations to address general safety and health issues. It is possible that had the programs noted below been in place, the FF-EMT would have been on restricted duty until he was medically cleared for full firefighting duty, possibly preventing his sudden cardiac death.

- ***Provide mandatory annual medical evaluations to fire fighters consistent with National Fire Protection Association (NFPA) 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.***
- ***Phase-in a comprehensive wellness and fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.***

- ***Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.***
- ***Secure endotracheal tubes to prevent dislodgment during patient treatment, transfer, and transport.***
- ***Reconsider routine use of coronary artery calcium scans.***

INTRODUCTION & METHODS

On February 19, 2007, a 44-year-old male FF-EMT collapsed during overhaul activities on the 6th floor of a high rise apartment building. Despite CPR and advanced life support administered by crew members, by the Fire Department ambulance crew, and in the Emergency Department, the FF-EMT died. NIOSH was notified of this fatality on February 21, 2007 by the United States Fire Administration. NIOSH contacted the affected Fire Department to gather additional information on February 26, 2007, and on May 6, 2008 to initiate the investigation. On May 12, 2008, a Safety and Occupational Health Specialist and a visiting research physician from the NIOSH Fire Fighter Fatality Investigation Team traveled to New York to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- Executive Deputy Fire Chief
- Deputy Chief for Training
- Fire Department Occupational Medicine Physician
- Local representative of the International Association of Fire Fighters (IAFF)
- Crew members on duty with the FF-EMT

NIOSH personnel reviewed the following documents:

- Fire Department policies and operating guidelines
- Fire Department training records of the FF-EMT
- Fire Department annual report for 2007
- Fire Department incident reports
- Police incident report
- Emergency medical service (ambulance) incident report
- Fire Department physical examination protocols
- Fire Department medical records of the FF-EMT
- Emergency department encounter form
- Death certificate
- Autopsy report
- Primary care provider medical records of the FF-EMT

RESULTS OF INVESTIGATION

Incident. On February 19, 2007, the FF-EMT reported for duty at his fire station at approximately 0800 hours. The FF-EMT served as the Acting Lieutenant on the 4-person Squad. From 0800 hours until 0845 hours, the crew checked the apparatus and equipment. The FF-EMT also completed paperwork that was required of the company officer. From approximately 0845 hours to 0925 hours, the Squad crew reported to another fire station for a cancer screening. After the screening, the Squad returned to its fire station. From this time until 1225 hours, the crew remained in the fire station and ate lunch.

At 1225 hours, the Rescue Squad, along with 3 engines, 2 aerials, and 3 other apparatus (including an ambulance) were dispatched to a fire in a two-story residence. The weather conditions included a temperature of 9°Fahrenheit, 39% relative humidity, and wind speed of 9 miles per hour, giving a wind chill of -4°F [NOAA 2004]. Upon arrival at 1227 hours, units found smoke emitting from the second floor window. The FF-EMT and a crew member, wearing full turnout gear and self-contained breathing apparatus (SCBA) on air, entered the structure and climbed to the second floor to assist with ventilation. They took out windows and assisted with extinguishing spot fires. The fire was declared under control at 1245 hours, but the Squad crew continued overhaul procedures until 1327 hours when they returned to their fire station. The crew spent the next two hours showering, cleaning their equipment, and filling SCBA bottles. The FF-EMT also completed paperwork during this time.

At 1642 hours, the Rescue Squad, along with 3 engines, 2 aerials, and 3 other apparatus (including an ambulance) were dispatched to a fire on the 6th floor of a 12-story high rise apartment building. The weather conditions included a temperature of 15°F, 42% relative humidity, and a wind speed of 10 miles per hour, giving a wind chill of 3°F [NOAA 2004]. Upon arrival at 1648 hours, units observed heavy black smoke emitting from 6th floor windows. The FF-EMT and a crew member, wearing full turnout gear and SCBA entered the building and climbed the stairs to the 6th floor. Their gear was still wet from the earlier fire response, therefore about 5 pounds heavier (total weight of the personal protective equipment was approximately 55 pounds). While an engine company was extinguishing the fire in the living room, the FF-EMT and a crew member, going on air, conducted a search of the bedroom for potential fire victims while ventilating the area. Finding no victims, the two assisted with extinguishing spot fires for about 30 minutes. Smoke alarms and the building sprinkler system continued to activate. The fire was knocked down at 1653 hours and overhaul began. After conducting his 2nd walkthrough looking for hot spots, the FF-EMT, still wearing full turnout gear and SCBA, but not on air, told his crew member that he wanted to conduct one more walkthrough and stated that, "the stairs were a killer." (He had climbed the stairs once). He took about 6 steps and collapsed face down.

The crew member thought the FF-EMT had tripped over the hoselines and tried to assist him. The crew member realized the FF-EMT was unresponsive and alerted dispatch and crew members (1702 hours). Shortly thereafter, the FF-EMT had no pulse and stopped breathing. Due to the noise of the smoke alarms and the activating sprinkler system, the crew member had difficulty in relaying the information to dispatch. The paramedic member of the Squad had gone to the apparatus to change his SCBA bottle when he heard the call for help. He obtained advanced life support equipment while other crew members retrieved the stretcher and ran up the stairs to the 6th floor lobby. CPR was being performed by crew members and the FF-EMT's gear was cut off. He was placed on a manual cardiac monitor, which revealed ventricular tachycardia, and three consecutive shocks were administered. His heart rhythm reverted to ventricular fibrillation. He was intubated and cardiac resuscitation medications were given via the intubation tube. A fourth shock was delivered and a heart rhythm returned with a pulse at a rate of 108 beats per minute. The pulse remained for about 2 minutes and suddenly stopped as the FF-EMT's heart rhythm reverted to ventricular fibrillation. No repeat shock was administered at this time.

He was placed onto a stretcher and an unsuccessful attempt was made to enter the elevator. Since the elevator was too small for the stretcher, the FF-EMT was removed from the stretcher and placed on the elevator floor (about 1710 hours). During the move, a 5th shock was delivered; his heart rhythm reverted to asystole (no heart beat). CPR continued as the elevator reached the 1st floor. It was noted that the intubation tube had become dislodged. The FF-EMT was carried to the ambulance, which departed the scene at 1718 hours en route to the hospital's emergency department.

En route, advanced life support procedures and CPR continued. An attempt to reintubate the FF-EMT was made, but this was unsuccessful and a CombiTube® was placed. Additional resuscitation medications were administered via the CombiTube®, but the FF-EMT's heart rhythm remained in asystole. No further IV attempts were made during transport.

The ambulance arrived at the hospital at 1724 hours. Inside the emergency department, CPR and advanced life support measures continued for the FF-EMT who was unresponsive with no heart beat and no spontaneous breathing. The CombiTube® was removed and an endotracheal tube was placed. Transcutaneous pacing (a temporary means of pacing a patient's heart during a medical emergency; accomplished by delivering pulses of electric current through the patient's chest, which stimulates the heart to contract) was initiated with capture, but no palpable pulses returned and pacing was stopped. An intravenous (IV) line was placed and cardiac resuscitation medications were administered via IV, with no positive change in the FF-EMT's condition. Resuscitation efforts continued until 1740 hours (about 38 minutes since his collapse), when the FF-EMT was pronounced dead by the attending physician.

Medical Findings. The death certificate, completed by the county coroner, and the autopsy,

completed by a pathologist on February 20, 2007, listed "ischemic heart disease" as the cause of death. Pertinent findings from the autopsy are located in Table 1.

The FF-EMT was 73" tall and weighed 271 pounds, giving him a body mass index (BMI) of 35.75. A BMI >30.0 kilograms per meters squared (kg/m2) is considered obese [National Heart, Lung, and Blood Institute 2005]. Medical records show the FF-EMT had elevated blood pressure since 1987, but was not diagnosed with hypertension until 1995. He was prescribed a blood pressure-lowering medication in 1995, although he stopped taking the medicine after two months. Over the next 12 years, his blood pressure (170/90 mmHg in 2006) was not well controlled due to variable compliance with antihypertensive medications, and difficulty following his diet and exercise programs.

The FF-EMT was diagnosed with high cholesterol in 2003, however available medical records did not indicate specific blood levels. Blood levels in 2005 included the following: LDL (214 milligrams per deciliter [mg/dL] [normal is 10-99 mg/dL]), HDL (41 mg/dL [normal is 40-59 mg/dL]), and cholesterol/HDL ratio (7.3 [normal is < 5.0]). The FF-EMT was never prescribed a cholesterol-lowering medication despite diet and exercise being unsuccessful in controlling his cholesterol. His primary care physician advised him during several office visits regarding diet, exercise, controlling his CAD risk factors, that his job as a fire fighter put him at greater risk of a cardiac event, and that his crew members relied on him.

In 2000, the FF-EMT had an episode of palpitations. His primary care physician ordered an electrocardiogram (EKG) which was normal. Thinking the palpitations were a result of too much caffeine, his primary care physician recommended reducing his caffeine intake. An echocardiogram was recommended, and performed. His left atrium was slightly dilated, but otherwise normal. The FF-EMT's most recent EKGs were conducted as part of the Fire Department periodic medical evaluation program in 2003 (periodic) and 2005 (HazMat). Both EKGs showed possible left atrial enlargement, and thus both had an automated reading of "borderline." Physician readings of these EKGs were normal.

The FF-EMT's most recent Fire Department medical evaluation (for HazMat) in 2005 revealed a mild restrictive pattern on his pulmonary function test (75% of predicted forced expiratory volume in 1 second [FEV1] [normal is ≥ 80%] and 78% of predicted forced vital capacity [FVC] [normal is ≥ 80%]) [Krumpe 1995]. The Fire Department physician considered this finding was probably due to his obesity.

According to crew members, the FF-EMT had no complaints of chest pains, unusual shortness of breath on exertion, or any other heart-related symptoms, days, weeks, or months prior to his death.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, the Fire Department consisted of 260 uniformed personnel and served a population of 95,000 residents in a geographic area of 27 square miles. There are 8 fire stations. Fire fighters work the following schedule: 24-hours on-duty, 72-hours off-duty, from 0800 hours to 0800 hours.

In 2007, the Fire Department responded to 20,077 calls: 15,903 rescue/emergency medical calls, 324 structure fires, 76 vehicle fires, 50 brush/grass fires, 87 refuse fires, 35 other fires, 1,636 false calls, 797 good intent calls, 642 service calls, 522 hazardous condition calls, and 5 overpressure rupture calls. In 2007, the Rescue Squad (the FF-EMT's assignment) responded to 2,074 calls (averaging 5.6 calls per day) and 114 inspections.

Employment and Training. The Fire Department requires all new fire fighter applicants to be 18 years of age, have a high school diploma or General Educational Development (GED) equivalent, be a state-certified EMT, and pass a State civil service test, a background check, an oral interview, a candidate physical ability test (CPAT) [IAFF/IAFC 1999], a pre-placement medical evaluation (described below), and a drug screen prior to being hired. The applicant must have a physician clearance prior to performing the CPAT. Newly-hired fire fighters must then pass the 12-16 week fire fighter training course at the City Fire Academy to become certified as a Fire Fighter I. The FF-EMT was certified as a Fire Fighter II, Driver/Operator, Fire Inspector, EMT, HazMat Technician, and had 20 years of firefighting experience.

Pre-placement Medical Evaluation. The Fire Department requires a pre-placement medical evaluation for all new hires, regardless of age. Components of this evaluation include the following:

- A complete medical history
- Physical examination (including vital signs)
- Complete blood count with lipid panel
- Pulmonary function test (PFT)
- Audiogram
- Vision screen
- Urinalysis
- Urine drug screen
- Resting EKG
- Chest x-ray (baseline)
- Mantoux tuberculosis (TB) skin test
- Hepatitis B vaccinations
- Vaccines or boosters (if needed) for the following:
  - — Tetanus/Influenza

These evaluations are performed by a City-contracted physician, who makes a determination regarding medical clearance for firefighting duties.

Periodic Medical Evaluations. Periodic (annual) medical evaluations are required by the Fire Department only for HazMat fire fighters. Components of this evaluation include:

- A complete medical history
- Physical examination
- Complete blood count with lipid and hepatitis panels
- Resting EKG
- PFT
- Audiogram
- Vision screen
- Urinalysis

These evaluations are performed by the City-contracted physician, who makes the final determination regarding medical clearance for firefighting duties. As mentioned earlier, the FF-EMT passed his HazMat physical evaluation in 2005, but missed his medical evaluation in 2004 and 2006.

Non-Hazmat fire fighters receive periodic medical evaluations based on age: 20-30 years old, every 3 years; 31-39 years old, every 2 years; and 40+ years old, every year. The components are the same as the HazMat medical evaluation. Members may elect to have their primary care physician conduct the periodic medical evaluation. However, the primary care physician must complete the Fire Department medical evaluation form. The City-contracted physician then reviews the completed form and makes the final determination regarding medical clearance.

SCBA medical clearance is required annually for HazMat fire fighters and periodically (age-based) for all other fire fighters. If an employee is injured at work, the employee must be evaluated by the City-contracted physician, who makes the final determination regarding "return to work." If the employee is off duty for three or more shifts due to non-occupational illness/injury, the employee must be evaluated by his/her primary care physician, who completes a Fire Department medical return-to-work form. The employee then provides this form to the City-contracted physician, who evaluates the employee and makes the final determination regarding "return to work."

The Fire Department has an extensive light duty program in which the injured employee works for 40 days in an administrative position and is re-evaluated by the City-contracted physician, who determines whether the employee can be rehabilitated to full duty or is placed in the State disability system.

Health and Wellness Programs. Exercise (strength and aerobic) equipment is located in the fire stations. The Fire Department maintains a voluntary on-duty wellness/fitness program. Health maintenance programs are also available from the City including nutrition information, a fitness trainer, free membership to the City gym, and coronary artery calcium scans (computerized tomography scan of the heart to detect the presence of calcium in the coronary arteries). An annual physical ability test is not required.

DISCUSSION

Coronary Artery Disease and the Pathophysiology of Heart Attacks. In the United States, CAD (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death [Meyerburg and Castellanos 2008]. Risk factors for its development include age over 45, male gender, family history of CAD, diabetes, high blood pressure, high blood cholesterol, smoking, and obesity/physical inactivity [AHA 1998]. The FF-EMT had four of these risk factors (male gender, high blood pressure, high blood cholesterol, and obesity), and had CAD on autopsy.

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades [Libby 2008]. However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion [Shah 1997]. 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 [Fuster et al. 1992]. This sudden blockage is primarily due to blood clots (thromboses) forming on top of atherosclerotic plaques. On autopsy, the FF-EMT had evidence of a remote (old) heart attack (fibrosis and scarring) and 90% occlusion (but no recent thrombus) in the left anterior descending coronary artery.

Establishing the occurrence of a recent (acute) heart attack requires any of the following: characteristic EKG changes, elevated cardiac enzymes, or coronary artery thrombus. In the FF-EMT's case, he regained a heart rhythm for a short time, but the EKG did not reveal characteristic changes, cardiac enzyme testing was not performed (but the enzymes do not become positive for at least 4 hours post-heart attack) [AHA 2006], and no thrombus was found at autopsy. However, occasionally (16-27% of the time) post-mortem examinations do not reveal the coronary artery thrombus/plaque rupture during acute heart attacks [Davies 1992; Farb 1995]. This FF-EMT suffered sudden cardiac death either due to 1) an acute heart attack without a thrombus being present at autopsy, or 2) a heart arrhythmia associated with any of the following conditions present in the FF-EMT: CAD, prior heart attack, left ventricular hypertrophy, or cardiomegaly.

The FF-EMT did not report any episodes of chest pain (angina) during physical activity (on or off-the-job), nor during this episode. This lack of chest pain, however, does not rule out a heart attack, because in up to 20% of individuals, the first evidence of CAD may be myocardial infarction or sudden death [Libby 2005; Thaulow et al. 1993].

Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks [Willich et al. 1993; Mittleman et al. 1993; Siscovick et al. 1984; Tofler et al. 1992]. The FF-EMT had responded to two structure fires and performed search and rescue operations and overhaul while wearing full turnout gear and SCBA. This activity expended at least 11 metabolic equivalent of tasks (METs), which is considered very heavy physical activity [Gledhill and Jamnik 1992]. Heart attacks

in fire fighters have been associated with alarm response, fire suppression, and heavy exertion during training (including physical fitness training) [Kales et al. 2003; Kales et al. 2007; NIOSH 2007]. Given the FF-EMT's underlying CAD, the heavy physical exertion of performing firefighting duties probably triggered a heart attack or a cardiac arrhythmia resulting in his sudden cardiac death.

Cardiomegaly/Left Ventricular Hypertrophy. On autopsy, the FF-EMT was found to have left ventricular hypertrophy and an enlarged heart. These conditions increase the risk for sudden cardiac death [Levy et al. 1990]. Hypertrophy of the heart's left ventricle is a relatively common finding among individuals with long-standing high blood pressure (hypertension), a heart valve problem, or chronic cardiac ischemia (reduced blood supply to the heart muscle) [Siegel 1997b]. Because the FF-EMT had a long history of high blood pressure, his left ventricular hypertrophy was probably due to this condition.

Screening Tests for Cardiac Disease – EKG. Could the FF-EMT's condition have been identified before his sudden death? The fact that the FF-EMT had no heart-related symptoms makes an earlier diagnosis very difficult. However, the FF-EMT did have a "borderline normal" EKG due to possible left atrial enlargement. This finding, coupled with the FF-EMT's episode of palpitations in 2000, led to his primary care physician recommending an echocardiogram. The echocardiogram revealed a slightly dilated left atrium, normal valves, and no left ventricular hypertrophy. Basically, a normal echocardiogram.

Screening Tests for Cardiac Disease – Stress Tests. Stress testing asymptomatic individuals for coronary artery disease is controversial. NFPA 1582 states, "Stress EKG with or without echocardiogram or radionuclide scanning shall be performed as clinically indicated by history or symptoms" and refers the reader to Appendix A [NFPA 2007a]. Items in Appendix A are not standard requirements, but are provided for "informational purposes only." Appendix A recommends that sub-maximal (85% of predicted heart rate) stress tests be used as a screening tool to evaluate a fire fighter's aerobic capacity. Maximal (e.g., symptom limiting) stress tests with imaging should be used for fire fighters with:

- abnormal screening sub-maximal tests
- cardiac symptoms
- known coronary artery disease
- Males over the age of 45 and females over the age of 55 with two or more risk factors for coronary artery disease. Risk factors are defined as hypercholesterolemia (total cholesterol greater than 240 mg/dL), hypertension (diastolic blood pressure greater than 90 mm Hg), smoking, diabetes mellitus, or family history of premature coronary artery disease (heart attack or sudden cardiac death in a first-degree relative less than 60 years old).

If the stress test is negative, it should be repeated when clinically indicated or at least every 5 years.

The American College of Cardiology / American Heart Association (ACC/AHA) has also published stress test guidelines [Gibbons 2002]. The ACC/AHA states that the evidence to conduct stress tests in asymptomatic individuals with diabetes mellitus is "Class IIa" which is defined as "conflicting evidence and/or a divergence of opinion about the usefulness/efficacy but the weight of the evidence/opinion is in favor." The ACC/AHA goes on to say the evidence is "less well established" (Class IIb) for the following groups:

1. Evaluation of persons with multiple risk factors as a guide to risk-reduction therapy with the risk factors essentially the same as the NFPA listed above.
2. Evaluation of asymptomatic men older than 45 years, and women older than 55 years:
    - Who are sedentary and plan to start vigorous exercise
    - Who are involved in occupations in which impairment might jeopardize public safety [e.g., fire fighters]
    - Who are at high risk for coronary artery disease due to other diseases (e.g. peripheral vascular disease and chronic renal failure)

The U. S. Department of Transportation has also provided guidance for those seeking medical certification for a commercial drivers license. Their expert medical panel recommended stress tests for asymptomatic "high risk" drivers [Blumenthal 2007]. They define high risk drivers as those with any of the following:

- Diabetes mellitus
- Peripheral vascular disease
- Person above the age of 45 with multiple risk factors for coronary heart disease
- Framingham risk score predicting a 20% coronary heart disease event risk over the next 10 years

Finally, the U.S. Preventive Services Task Force (USPSTF) does not recommend stress tests for asymptomatic individuals, even those with risk factors for coronary artery disease. Rather, they recommend the diagnosis and treatment of modifiable risk factors (hypertension, high cholesterol, smoking, and diabetes) [USPSTF 1996]. The USPSTF indicates that there is insufficient evidence to recommend screening middle age and older men or women in the general population but notes that "screening individuals in certain occupations (pilots, truck drivers, etc.) can be recommended on other grounds, including the possible benefits to public safety."

Given that this FF-EMT was asymptomatic and age 44, none of the above organizations

would have recommended a diagnostic stress test. If, however, the Fire Department was conducting screening sub-maximal aerobic capacity tests, perhaps the FF-EMT's condition could have been identified and referred on for further evaluation and treatment.

Screening tests for CAD – Coronary Artery Calcium by Computed Tomography (CT). The Fire Department provides coronary artery calcium CT scans to fire fighters as part of its wellness program. In 2007, the ACC/AHA updated its consensus document on this issue. The committee considers the use of coronary calcium measurement by coronary CT scans reasonable in asymptomatic individuals at intermediate risk of coronary heart disease (between 10% and 20% risk of a coronary event in the next 10 years) [Greenland et al. 2007]. It does not consider these tests indicated if the 10-year risk is >20% or <10%.

RECOMMENDATIONS

The NIOSH investigator offers the following recommendations to address general safety and health issues. It is possible that had the programs noted below been in place, the FF-EMT would have been on restricted duty until he was medically cleared for full firefighting duty, possibly preventing his sudden cardiac death.

Recommendation #1: Provide mandatory annual medical evaluations to fire fighters consistent with National Fire Protection Association (NFPA) 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

We commend the Fire Department for having a periodic medical evaluation program for all fire fighters. This program uses age to determine the medical evaluations and is similar to that in the 2000 edition of NFPA 1582 [NFPA 2000]. More recent editions of NFPA 1582 (2003, 2005, and 2008) require annual (not age based) medical evaluations. We recommend the City and Union work together to establish an annual medical evaluation whose content is similar/consistent with the most recent NFPA 1582 guidelines. Additional guidance can be found in the IAFF/ International Association of Fire Chiefs (IAFC) Fire Service Joint Labor Management Wellness/Fitness Initiative [IAFF, IAFC 2000]. However, the Fire Department is not legally required to follow either document.

Recommendation #2: Phase-in a comprehensive wellness and fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.

We commend the Fire Department for developing a voluntary wellness and fitness program. Worksite health promotion programs have been shown to be not only effective in improving health, but cost effective by increasing productivity, reducing absenteeism, reducing the number of work-related injuries, and reducing the number of work-related lost work days [Aldana 2001]. Fire service health

promotion programs have been shown to reduce CAD risk factors and improve fitness levels, with mandatory programs showing the most benefit [Blevins et al. 2006; Dempsey et al. 2002; Garfi et al. 1996; Harger et al. 1999; Kuehl 2007; Stevens et al. 2002; Womack et al. 2005]. Further guidance for mandatory fire department wellness/fitness programs include NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters, and the IAFF/IAFC Fire Service Joint Labor Management Wellness/Fitness Initiative [NFPA 2008; IAFF, IAFC 2000].

Recommendation #3: Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.

NFPA 1500 requires Fire Department members who engage in emergency operations to be annually evaluated and certified by the Fire Department as having met the physical performance requirements identified in paragraph 8-2.1 of the standard [NFPA 2007b].

Recommendation #4: Secure endotracheal tubes to prevent dislodgment during patient treatment, transfer, and transport.

After the endotracheal tube is inserted into the trachea and positive breath sounds are confirmed by auscultation and end-tidal CO2, the tube should be secured in place by a specific, validated technique or device to prevent dislodgement [AHA 2000]. These techniques include taping and strapping. This was performed in this case, however due to the circumstances in moving the FF-EMT, the endotracheal tube became dislodged and subsequent effort to re-intubate in the ambulance was not successful.

Recommendation #5: Reconsider routine use of coronary artery calcium scans.

Again, the ACC/AHA committee considers the use of coronary calcium measurement by coronary CT scans reasonable in asymptomatic individuals at intermediate risk of coronary heart disease (between 10% and 20% risk of a coronary event in the next 10 years). It does not consider these tests indicated if the 10-year risk is >20% or <10%. The Fire Department should adjust this program to be consistent with the ACC/AHA guideline.

Table 1
Autopsy Findings

- Cardiomegaly (heart weighed 560 grams [g]; normal weight is <400 g) [Siegel 1997a]
- Atherosclerotic CAD
  - Severe (90%) focal narrowing of the left anterior descending coronary artery
  - Moderate (70%) focal narrowing of the right coronary artery
  - No evidence of thrombus (blood clot) in the coronary arteries
- Fibrosis of the posterior left ventricle consistent with a remote (old) myocardial infarction (heart attack)
- Left ventricular hypertrophy
  - Left ventricular wall thickened (1.8 centimeters [cm];
  - normal by autopsy is 0.76-0.88 cm [Colucci and Braunwald 1997];
  - normal by echocardiographic measurement is 0.6-1.1 cm) [Armstrong and Feigenbaum 2001]
- Normal cardiac valves
- No evidence of a pulmonary embolus (blood clot in the lung arteries)
- Negative drug and alcohol tests
  - (Amphetamines, barbiturates, benzodiazepines, benzoylegonine, methadone, opiates, phencyclidine, propoxyphene, cannabinoids, tricyclic antidepressants, ethanol, isopropanol, methanol)
- Carboxyhemoglobin 1.8% (normal, suggesting no significant carbon monoxide exposure)

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Fire Fighter-Emergency Medical Technician Suffers Sudden Cardiac Death During Overhaul – New York

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In fiscal year 1998, the Congress appropriated funds to NIOSH to conduct a fire fighter initiative. NIOSH initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program website at

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