



Death in the line of duty...

NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

A summary of a NIOSH fire fighter fatality investigation

March, 2013

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Executive Summary

On March 29, 2010, a 56-year-old male career Paramedic Training Instructor/Coordinator (PTI/C) was found dead in his quarters in the fire department's (FD) training facility. He was serving in his regular assignment as a PTI/C, and was working alone before his collapse. He was last seen by a co-worker on March 26 providing cardiopulmonary resuscitation (CPR) training at a local church as part of the FD's community relations program. On March 29, a co-worker noticed the PTI/C's vehicle in the facility's parking lot and went to check on him. He was discovered in a state of rigor mortis in his quarters at approximately 1604 hours. Dispatch was alerted and CPR was started as emergency responders arrived on scene at 1607 hours. After assessing the PTI/C, emergency responders pronounced him dead at 1610 hours. The death certificate listed "cardiopulmonary arrest" as the immediate cause of death with "hyperlipidemia," "CVA," and "HTN" as underlying causes. No autopsy or toxicology testing was performed.

It is unlikely that any of the following recommendations could have prevented the PTI/C's death. Nonetheless, NIOSH investigators offer the following recommendations to address general safety and health issues.

Modify the policy for fire fighter exercise stress tests.

Provide an annual medical evaluation to all fire fighters.

Consider performing annual physical performance (physical ability) evaluations for all members.

Perform an autopsy on all on-duty fire fighter fatalities.

Phase in a mandatory wellness and fitness program for fire fighters.

Introduction & Methods

On March 29, 2010, a 56-year-old career PTI/C was found in a state of rigor mortis at the FD's training facility. NIOSH was notified of this fatality on March 31, 2010 by the U.S. Fire Administration. NIOSH contacted the affected FD shortly thereafter, and again on March 2, 2011 to request further information and schedule an investigation. On March 30, 2011 a contractor for the NIOSH Fire Fighter Fatality Investigation Team (the NIOSH investigator) conducted an on-site investigation of the incident.

During the investigation, the NIOSH investigator interviewed the following people:

- Assistant Fire Chief
- FD human resources representative

The NIOSH investigator reviewed the following documents in preparing this report:

- Death certificate
- The PTI/C's medical records maintained by the FD
- Emergency medical service report
- FD training records
- FD Annual Report for 2010
- Components of the FD's medical evaluation program

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

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 1998, Congress appropriated funds to NIOSH to conduct a fire fighter initiative that resulted in the NIOSH "Fire Fighter Fatality Investigation and Prevention Program" which examines line-of-duty-deaths or on duty deaths of fire fighters to assist fire departments, fire fighters, the fire service and others to prevent similar fire fighter deaths in the future. The agency does not enforce compliance with State or Federal occupational safety and health standards and does not determine fault or assign blame. Participation of fire departments and individuals in NIOSH investigations is voluntary. Under its program, NIOSH investigators interview persons with knowledge of the incident who agree to be interviewed and review available records to develop a description of the conditions and circumstances leading to the death(s). Interviewees are not asked to sign sworn statements and interviews are not recorded. The agency's reports do not name the victim, the fire department or those interviewed. The NIOSH report's summary of the conditions and circumstances surrounding the fatality is intended to provide context to the agency's recommendations and is not intended to be definitive for purposes of determining any claim or benefit. For further information, visit the program website at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Investigative Results

Incident. The PTI/C was last seen by a co-worker on Friday, March 26 when they provided CPR training at a local church as part of the FD's community relations program. At that time he did not complain of any health problems or cardiac symptoms. On Monday March 29, a co-worker noticed the PTI/C's vehicle in the facility's parking lot and went to check on him. He was discovered in a state of rigor mortis in his quarters at approximately 1604 hours. Dispatch was alerted and CPR was started as the emergency responders arrived on scene at 1607 hours. After assessing the PTI/C, emergency responders pronounced him dead at 1610 hours.

The PTI/C probably collapsed sometime during the day of March 29 because March 27-28 was a weekend and the PTI/C was not scheduled to work. Since he was alone, the type of work he was doing when he collapsed is unknown.

Medical Findings. The death certificate listed "cardiopulmonary arrest" as the immediate cause of death with "hyperlipidemia," "CVA," and "HTN" as underlying causes. No autopsy or toxicology testing was performed.

The PTI/C was 71 inches tall and weighed 214 pounds, giving a body mass index of 29.8 kilograms per meter squared. A body mass index of 25.0-29.9 is considered overweight [CDC 2011]. He had a history of atherosclerotic heart disease, myocardial infarction, coronary bypass surgery, hypercholesterolemia, stroke, and hypertension.

Description of the Fire Department

The FD consists of approximately 1500 career professional firefighters working out of 32 fire stations and serving a population of approximately 792,000 residents. The FD provides services in an area of 240 square miles. The FD responded to 148,918 calls in 2010.

Employment and Training. The FD hiring requirements are those of the city civil service requirements with no maximum age for applicants. Firefighters undergo State-mandated on-going training for firefighters (52 hours every 3 years), for certified Fire Safety Inspectors (32 hours every 3 years), for EMT-basic (40 hours every 3 years), and for EMT-paramedic (56 hours every 3 years). The PTI/C was certified as a Fire Fighter Level 2, CPR Instructor, Flight Medic, Fire Safety Inspector, Hazardous Materials, and EMT-paramedic. He had 34 years of firefighting experience.

Post-Offer/Pre-placement Medical Evaluations. New hires receive a complete medical evaluation which includes a health history, physical examination, blood chemistry testing, pulmonary function testing, vision testing, hearing testing, and chest X-ray. The examinations are performed by medical contractors at local hospitals. An examination is required before new hires undergo a mandatory physical fitness test. The PTI/C had a preplacement medical evaluation prior to joining the department. It included history, physical examination, electrocardiogram, chest x-ray, complete blood count, blood chemistry profile, urinalysis, spirometry, hearing test, and vision test. He passed this medical evaluation and joined the FD in 1975.

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Description of the FD (cont.)

Periodic Medical Evaluations. All firefighters undergo annual respirator medical clearance as required by the OSHA respiratory protection standard. A more comprehensive medical evaluation is conducted periodically, with the frequency determined by the member's age. Elements of the medical evaluation are medical history, physical examination, blood chemistry (cholesterol, triglycerides, high density lipoprotein, low density lipoprotein, thyroid function, sodium, potassium, BUN, creatinine, chloride, fasting glucose, liver enzymes, prostate specific antigen (for males over 40), vision and hearing testing, and a chest x-ray every 3 years. Members under age 40 receive medical evaluations every other year. Members age 40 and over receive annual medical evaluations including cardiac stress tests every 3 years. In addition, some specialized firefighters (e.g., Hazmat) are required to have annual medical evaluations, regardless of their age.

The medical evaluations are performed by contractors operating out of local hospitals. A firefighter with injuries or illnesses is required to get medical clearance from his/her personal physician for return to work.

The PTI/C's most recent medical evaluation was on January 20, 2010. He underwent blood tests, a urinalysis, spirometry, and electrocardiogram. His electrocardiogram showed previous myocardial infarctions. No exercise stress test was performed. His cholesterol levels were normal except for low HDL cholesterol. He was cleared to work as the PTI/C.

Fitness/Wellness Programs. FD members receive periodic physical fitness assessments

at the same frequency as the periodic medical evaluations. These assessments include body composition analysis, cardiorespiratory endurance (stress treadmill using the standard Bruce protocol and electrocardiogram), flexibility, and upper body/lower body/abdominal strength. Members receive a copy of their test results. Members who do not meet the applicable fitness standards (based on age and sex) are placed in a mandatory physical fitness training program. Firefighters can work out on fitness equipment available at fire stations and are offered incentives for their participation. The FD also offers a wellness program which includes nutrition counseling, weight control, and smoking cessation. The FD also has a voluntary employee assistance program.

Discussion

Atherosclerotic Coronary Artery Disease. Atherosclerotic coronary artery disease (CAD) is the most common risk factor for cardiac arrest and sudden cardiac death [Meyerburg and Castellanos 2008]. Risk factors for CAD include male gender, age greater than 45 years, family history of CAD, hypertension, smoking, elevated cholesterol, diabetes, and obesity/physical inactivity [AHA 2010, NHLBI 2011]. The PTI/C had a history of four CAD risk factors (male gender, age greater than 45 years, hypertension, and elevated cholesterol). His previous myocardial infarctions and coronary bypass surgery confirm the presence of CAD.

Cerebrovascular Disease / Cerebrovascular Attack (CVA). The death certificate listed CVA (otherwise known as a stroke) as an underlying cause of his death. Stroke is the sudden development of a focal neurological deficit [Spraycar 1995].

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Discussion (cont.)

Risk factors for stroke include male gender, age greater than 55 years, race (African Americans have a higher risk of dying from strokes than Caucasians), family history of stroke, prior history of stroke or heart attack, hypertension, smoking, diabetes, carotid artery disease, peripheral artery disease, atrial fibrillation, sickle cell anemia, elevated cholesterol, obesity, and physical inactivity [AHA/ASA 2006]. The PTI/C had many of these risk factors, and had a CVA.

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, the NFPA developed NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments [NFPA 2007a, 2013]. The PTI/C did not have the same job duties as a fire fighter and would not need to meet the medical fitness for duty requirements of NFPA 1582.

Recommendations

It is unlikely that any of these recommendations could have prevented the PTI/C's sudden cardiac death. Nonetheless, NIOSH investigators offer the following recommendations to address general safety and health issues.

Recommendation #1: Modify the policy for fire fighter exercise stress tests.

Rather than using age as the sole criterion to initiate exercise stress tests, consider using the member's age and the number and severity of CAD risk factors. Guidance for cardiac stress tests varies by organization as summarized in the following paragraphs.

National Fire Protection Association (NFPA) 1582, a voluntary industry standard, recommends an exercise stress test performed "as clinically indicated by history or symptoms" and refers the reader to Appendix A [NFPA 2007a, 2013]. Items in Appendix A are not standard requirements, but are provided for "informational purposes only." Appendix A recommends using submaximal (85% of predicted heart rate) stress tests 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 the following conditions:

- abnormal screening submaximal tests
- cardiac symptoms or known CAD
- one or more risk factors for CAD (in men older than 45 and women older than 55)
- a Framingham Risk Score >10%.

Risk factors are defined as hypercholesterolemia (total cholesterol greater than 240 milligrams per deciliter), hypertension (diastolic blood pressure greater than 90 mm of mercury), smoking, diabetes mellitus, or family history of premature CAD (heart attack or sudden cardiac death in a first-degree relative less than 60 years old).

The American College of Cardiology/American Heart Association (ACC/AHA) has also published exercise testing guidelines [Gibbons et al. 2002]. The ACC/AHA guideline 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 guideline states the evidence is "less well established" (Class IIb) for the following groups:

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Recommendations (cont.)

- persons with multiple risk factors (defined similarly to those listed by the NFPA)
- 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 (DOT) provides guidance for those seeking medical certification for a commercial drivers' license. An expert medical panel recommended exercise tolerance tests (stress tests) for asymptomatic "high risk" drivers [Blumenthal 2007]. The panel defines high risk drivers as those with any of the following:

- diabetes mellitus
- peripheral vascular disease
- age 45 and above with multiple risk factors for coronary heart disease
- Framingham risk score predicting a 20% coronary heart disease event risk over the next 10 years

The U.S. Preventive Services Task Force (USPSTF) does not recommend stress tests for asymptomatic individuals at low risk for coronary heart disease events. For individuals at increased risk for coronary heart disease events, the USPSTF found "insufficient evidence to recommend for or against routine screening with EKG, exercise tolerance test, or electron beam computerized tomography scanning..." Rather, they recommend the diagnosis and treatment of modifiable risk factors (hypertension, high cholesterol, smok-

ing, and diabetes) [USPSTF 2004]. The USPSTF does note that "For people in certain occupations, such as pilots, and heavy equipment operators (for whom sudden incapacitation or sudden death may endanger the safety of others), consideration other than the health benefit to the individual patient may influence the decision to screen for coronary heart disease."

Recommendation #2: Provide an annual medical evaluation to all fire fighters.

Annual medical evaluations have two purposes. First, they can screen for unidentified medical conditions. Second, they can be used to determine fire fighters' medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others. Guidance regarding the content and frequency of these medical evaluations can be found in NFPA 1582 and the IAFF/IAFC Fire Service Joint Labor Management Wellness/Fitness Initiative [IAFF, IAFC 2008; NFPA 2007a, 2013]. However, the FD is not legally required to follow this guidance. In addition, applying this recommendation involves economic repercussions and may be difficult to implement.

Recommendation #3: Consider performing annual physical performance (physical ability) evaluation for members who engage in emergency operations.

The FD currently requires physical assessments on a biannual basis for members younger than 40. NFPA 1500 recommends that FD members who engage in emergency operations have annual assessments [NFPA 2007b]. This ensures fire fighters are physically capable of performing the

Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

Recommendations (cont.)

essential job tasks of structural fire fighting.

Recommendation #4: Perform an autopsy on all on-duty fire fighter fatalities.

In 2008, the USFA published the Firefighter Autopsy Protocol [USFA 2008]. With this publication, the USFA 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 #5: Phase in a mandatory wellness and fitness program for fire fighters.

Guidance for wellness and fitness programs for fire fighters is found in NFPA 1583 Standard on Health-Related Fitness Programs for Fire Fighters, the IAFF/IAFC Fire Service Joint Management Wellness/Fitness Initiative, and in Firefighter Fitness: A Health and Wellness Guide [IAFF/IAFC 2008; NFPA 2008; Schneider 2010]. Worksite health promotion programs have been shown to be cost effective by increasing productivity, reducing absenteeism, and reducing the number of work-

related injuries and lost work days [Stein et al. 2000; 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 [Dempsey et al. 2002; Womack et al. 2005; Blevins et al. 2006]. A study conducted by the Oregon Health and Science University reported a savings of more than \$1 million for each of four large fire departments implementing the IAFF/IAFC wellness/fitness program compared to four large fire departments not implementing a program. These savings were primarily due to a reduction of occupational injury/illness claims with additional savings expected from reduced future nonoccupational healthcare costs [Kuehl 2007]. The FD currently has a voluntary wellness/fitness program. NIOSH recommends a formal, mandatory wellness/fitness program to ensure all members receive the benefits of a health promotion program.

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Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

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Paramedic Training Instructor/Coordinator Found Dead in His Quarters - OH

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Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio. Clara Sue Ross, MD led the investigation and coauthored the report. Dr. Ross is a board-certified occupational medicine physician. She was working as a contractor with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component during this investigation. Thomas Hales, MD, MPH, provided medical consultation and coauthored the report. Dr. Hales is a member of the NFPA Technical Committee on Occupational Safety and Health, and Vice Chair of the Public Safety Medicine Section of the American College of Occupational and Environmental Medicine (ACOEM).