Trainee Suffers Heart Attack During Fire Fighter Training and Dies—Michigan

Executive Summary

On January 2, 2016, a 47-year old trainee was participating in his fire department's search and rescue training. After 3 hours in the classroom, practical training began. It involved doing primary searches while wearing full turnout gear and self-contained breathing apparatus (SCBA). After about 1½ hours of practical training, the students took a break. The Trainee sat down, removed his turnout coat, and drank Gatorade®. He became dizzy and lightheaded and laid down onto the floor. He denied having chest pains, sat up, and drank more Gatorade®. He then vomited and became unresponsive. Dispatch was notified and an ambulance was requested. Ambulance paramedics hooked up a cardiac monitor. It revealed a heart attack. Aspirin was given, the hospital's emergency department (ED) was notified, and the emergency cardiac catheterization team was mobilized. Upon arrival in the ED, an EKG confirmed a heart attack. The Trainee was taken for emergent cardiac catheterization. Severe three-vessel coronary artery disease was identified. The Trainee's distal right coronary artery was occluded. He had several episodes of ventricular fibrillation followed by cardiac arrest. Resuscitation efforts were unsuccessful. The Trainee was pronounced dead by the attending physician.

The death certificate listed "coronary artery disease" as the cause of death. No autopsy was performed. The Trainee's coronary heart disease (CHD) was undiagnosed prior to this incident. The underlying CHD and the physical stress of the training probably triggered the Trainee's fatal heart attack.

Key Recommendations

- *Provide preplacement and annual medical evaluations to all fire fighters consistent with NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments, to identify fire fighters at increased risk for coronary heart disease (CHD)*
- *Ensure exercise stress tests (ESTs) are performed on fire fighters at increased risk for CHD*
- *Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the components of NFPA 1582*

The following recommendations address general safety and health issues and would have not prevented the Trainee's death:

- *Perform an annual physical ability evaluation*
- *Phase in a mandatory comprehensive wellness and fitness program for fire fighters*

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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).

2016
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Death in the line of duty...

NIOSH Fire Fighter Fatality Investigation and Prevention Program

A summary of a NIOSH fire fighter fatality investigation

August 17, 2016

Trainee Suffers Heart Attack During Fire Fighter Training and Dies—Michigan

Introduction

On January 2, 2016, a 47-year old paid/call trainee (the "Trainee") suffered a fatal heart attack during fire fighter training. NIOSH was notified of this fatality on January 4, 2016, by the U.S. Fire Administration. NIOSH contacted the affected fire department (FD) on January 5, 2016, to gather additional information and on January 20, 2016, to initiate the investigation. On February 10, 2016, a safety and occupational health specialist from the NIOSH Fire Fighter Fatality Prevention and Investigation Program conducted an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:
- Fire Chief
- Fire Department Training Officer
- Lead Training Instructor
- Assistant Training Instructor
- Crewmembers
- Trainee's spouse

NIOSH personnel reviewed the following documents:
- FD standard operating guidelines
- Emergency medical service (ambulance) report
- Hospital ED records
- Hospital cardiac catheterization records
- Death certificate
- Primary care physician records

Investigation

On January 2, 2016, the Trainee and 16 other students arrived at the fire station at about 0800 hours for search and rescue training. From 0800 hours to 1100 hours, the students participated in classroom training. The class then assisted the three instructors set up the practical scenario. The training room was dark and filled with simulated smoke. At about 1140 hours, the students began primary searches of the training room. They were wearing full turnout gear and SCBA (on-air).

At about 1220 hours, the class took a break. The Trainee removed his turnout coat and sat on the floor next to an engine in the apparatus bay. He was sweating heavily but was drinking Gatorade®. Feeling dizzy and lightheaded, the Trainee lay on the floor. He denied having chest pain. An instructor helped him sit up and drink more Gatorade®. The Trainee vomited, began shaking, and became unresponsive. Dispatch was called and an ambulance was requested (1242 hours).

The Trainee was helped to the floor and responded to a sternal rub. Oxygen was administered via nasal cannula and vital signs were taken; pulse rate was 100 bpm (normal is 60-100) and blood pressure was 170/110 mmHg (normal is 120/80 mmHg). The Trainee denied having chest pains or difficulty breathing. He stated that he was a diabetic and had not eaten very much that day. The instructor told the Trainee he would need to be transported to the hospital, but the Trainee stated he felt much better and did not want to go. The instructor told the Trainee that because the incident occurred during training, there was no choice. At 1250 hours, the Trainee had a pulse rate of 97 bpm and a blood pressure of 140/60 mmHg.

The ambulance arrived on the scene at 1251 hours. Paramedics assisted the Trainee to a cot, placed him on the cardiac monitor, and started an intravenous line. The cardiac monitor revealed "inferior and anterior ST-segment elevation, consider acute infarct, meets ST elevation myocardial infarction (STEMI) criteria [evidence of a heart attack], sinus tachycardia [rapid heartbeat], and left bundle branch block." He had a pulse rate of 104 bpm, a blood pressure of 129/76 mmHg, and a respiratory rate of 18 breaths per minute (1258 hours). A blood glucose reading revealed a blood sugar level of 469 milligrams per deciliter (mg/dL) (normal is 60-115 mg/dL).

The ambulance departed the scene at 1305 hours en route to the ED. They notified the ED to prepare the emergency cardiac catheterization team. The Trainee's clinical status did not change while en route. One dose of aspirin was given and a second intravenous line was placed.

The ambulance arrived at the ED (1319 hours). On examination, an EKG confirmed a heart attack (myocardial infarction). The Trainee's cardiac enzymes revealed troponin T levels of <0.01 and 0.02 nanograms per milliliter (normal is ≤ 0.04). The Trainee was taken emergently for cardiac catheterization where severe three-vessel coronary artery disease (an acutely occluded (100%) distal right coronary artery, the left anterior descending coronary artery with 90% stenosis, and the circumflex coronary artery with distal chronic total (100%) occlusion) was revealed. A thrombectomy of the right coronary artery was attempted but the cardiologist had difficulty getting the catheter to the distal segment. After this procedure began, the Trainee suffered ventricular fibrillation. He was defibrillated twice and regained heart rhythm and blood pressure. As a balloon catheter was used to "dotter (passage of a catheter across a lesion without dilatation) the distal and proximal lesion," he went into his third episode of ventricular fibrillation. He was revived following extensive interventions (CPR, IV medications, multiple defibrillation attempts, and a pacemaker). Five stents were placed in the right coronary artery, but blood flow did not return. The Trainee was in cardiogenic shock and suffered his fourth cardiac arrest. After 10 additional minutes of unsuccessful resuscitation efforts, the attending physician pronounced the Trainee dead at 1613 hours.

Medical Findings

The death certificate, completed by the Certifying Physician, listed "coronary artery disease" as the cause of death. No autopsy was performed.

The Trainee had the following medical conditions:

Hypertension (Stage II) - first diagnosed in 2004 and began prescription anti-hypertensive medication in 2004. With treatment, his blood pressure was stable with occasional elevated readings; his last clinic reading in December 2015 was 155/97 mmHg (normal is 120/80) (Stage II is >160 mmHg systolic or > 100 mmHg diastolic).

Type 2 diabetes mellitus – first diagnosed in 2005 and treated with diet and insulin. His diabetes was poorly controlled (most recent blood glucose reading in September 2015 was 362 mg/dL (normal is 60-115 mg/dL). His hemoglobin A1c blood level was 11.4% (normal is <7.0%) and he had diabetic neuropathy (diagnosed in 2014 and prescribed an opioid analgesic for pain in September 2015).

Hyperlipidemia – first diagnosed in 2007 and prescribed a lipid-lowering medication in 2009. However, he was noncompliant with taking the medication. In September 2015 he had an elevated blood cholesterol level of 232 mg/dL (normal is < 200 mg/dL), an elevated triglyceride blood level of 367 mg/dL (normal is <150 mg/dL), a normal blood low density lipoprotein (LDL) level of 122 mg/dL, and a decreased blood high density lipoprotein (HDL) level of 37 mg/dL (normal is >39 mg/dL).

Metabolic Syndrome – The Trainee had four of the five conditions defining metabolic syndrome: hypertriglyceridemia, low HDL-C (< 40 mg/dL), hypertension (> 135/85 mmHg), and elevated fasting glucose (> 110 mg/dL) [NFPA 2013a].

Obesity – The Trainee was 72 inches tall and weighed 270 pounds at his sleep clinic visit in December 2015, giving him a body mass index of 36.6 kilograms per meters squared [CDC 2015].

Obstructive Sleep Apnea – The Trainee was diagnosed with sleep apnea in 2013. At the time his body mass index was 33.4. He was treated with continuous positive airway pressure and, according to medical records, was compliant with the treatment about half of the time.

Fire Department

At the time of the NIOSH investigation, the fire department consisted of one fire station with 28 uniformed personnel (26 paid/call and 2 full time). It served 8,800 residents in a geographic area of 36 square miles.

Employment, Membership, and Training

The fire department requires new fire fighter applicants to be 18 years of age; have a high school diploma or a general education development (GED) diploma; have a valid state driver's license; pass an oral interview with the fire chief, an oral interview with their spouse and the fire chief, and an officer interview prior to being hired. The new paid/call member begins state fire fighter council fire fighter I and II training. During the 6-month, 270-hour course, the member must complete a physical agility test consisting of a stair climb endurance test, hose drag, equipment carry drill, ladder raise test, forcible entry for safety, search training, rescue training, and ceiling breach. The full time member

works Monday to Friday, 0700 hours to 1600 hours. Paid/call members receive compensation for emergency responses. The Trainee had been a member of this fire department for 2 months and had completed 13 classes. He was a retired sheriff's deputy and was serving as a part time police officer for the township.

Preplacement Medical Evaluation/Periodic Medical Evaluations/Return to Work Medical Evaluations

The fire department does not require a preplacement or an annual medical evaluation. Medical clearance to wear SCBA and mask fit test is required annually. Members complete a questionnaire that is reviewed by an occupational health nurse. Members injured on duty are evaluated by the attending physician and the results are provided to the fire chief, who makes the final determination regarding return to duty. Members who are ill and miss work at their regular job must be evaluated by the attending physician who forwards their return to work decision to the fire chief, who makes the final determination regarding return to duty.

Wellness/Fitness Programs

The fire department does not have a wellness/fitness program and fitness equipment is not available in the fire station. An annual physical agility test is not required. The Trainee exercised about three times per week by walking for 30 minutes each time.

Discussion

Sudden Cardiac Events

In the United States, atherosclerotic CHD is the most common risk factor for cardiac arrest and sudden cardiac death [Meyerburg and Castellanos 2008]. Risk factors for its development are grouped into non-modifiable and modifiable. Non-modifiable risk factors include age older than 45, male gender, and family history of coronary artery disease. Modifiable risk factors include diabetes mellitus, smoking, high blood pressure, high blood cholesterol, and obesity/physical inactivity [NHLBI 2015; AHA 2016]. The Trainee had two non-modifiable risk factors (age older than 45 and male gender), four modifiable CHD risk factors (diabetes mellitus, high blood pressure, high blood cholesterol, and obesity/physical inactivity). Severe triple vessel CHD was found during this incident.

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades [Libby 2013]. However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion. Heart attacks (myocardial infarctions) typically occur with the sudden development of complete blockage (occlusion) in one or more coronary arteries that have not developed a collateral blood supply. This sudden blockage is primarily due to blood clots (thromboses) forming on top of atherosclerotic plaques [Libby 2013]. Establishing a recent (acute) heart attack requires any of the following: characteristic EKG changes, elevated cardiac enzymes, or coronary artery thrombus. In this case, the Trainee's EKGs revealed ST-segment elevation consistent with a heart attack, and his cardiac catheterization confirmed the presence of an acute thrombus. Troponin levels were normal about 2 hours after the incident began; they take 4-6 hours to become positive for a myocardial infarction.

Physiological Stress of Firefighting

Heart attacks and sudden cardiac death can be triggered by heavy physical exertion [Mittleman 1993; Willich 1993; Albert et al. 2000]. Among fire fighters, sudden cardiac events have been associated with, or triggered by, alarm response, fire suppression, or heavy exertion during training (including physical fitness training) [Kales et al. 2003; Kales et al. 2007; NIOSH 2007]. The Trainee's activities immediately preceding the incident expended about 6 metabolic equivalents, which is considered moderate physical activity [Gledhill and Jamnik 1992; Ainsworth et al. 2011]. The Trainee's fatal heart attack was probably triggered by this physical exertion.

Occupational Medical Standards for Structural Fire Fighters

To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, the National Fire Protection Association (NFPA) developed NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments* [NFPA 2013a]. This voluntary industry standard provides the components of a preplacement and annual medical evaluation and medical fitness for duty criteria. Components for candidates are divided into two categories: Category A (a medical condition that would preclude a person from performing as a member in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others) and Category B (a medical condition that, based on its severity or degree, could preclude a person from performing as a member in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others). The Trainee had several conditions addressed by NFPA 1582: 1) poorly controlled Stage II hypertension, 2) undiagnosed metabolic syndrome, 3) poorly controlled type 2 diabetes mellitus, and 4) undiagnosed CHD.

Hypertension. The Trainee fluctuated between Stage I and Stage II hypertension. NFPA 1582 considers uncontrolled or poorly controlled hypertension to be a Category A condition. Candidates with Stage I or Stage II hypertension should be referred to their primary care physician for evaluation, lifestyle modification, and/or treatment [NFPA 2013a]. After appropriate and successful management of Stage I or Stage II hypertension, a candidate can be re-evaluated after at least 1 month [NFPA 2013a]. The Trainee's hypertension was diagnosed in 2004. According to NFPA 1582, he should have been referred to his primary care physician for evaluation and screening for hypertension complications [NFPA 2013a].

Metabolic Syndrome. Metabolic syndrome is associated with reduced aerobic capacity and increased risk for cardiovascular ischemic disease, insulin resistant hyperglycemia, and hypertension. NFPA 1582 considers metabolic syndrome with aerobic capacity less than 12 METs to be a Category A condition; for aerobic capacity greater than 12 METs, a Category B condition. An EST should have been performed to determine the Trainee's aerobic capacity (e.g., MET level).

Narcotics. NFPA 1582 states that fire fighter candidates who are treated with narcotics are included in Category A and should be restricted from duty [NFPA 2013a].

Obstructive Sleep Apnea. NFPA 1582 considers untreated obstructive sleep apnea as a condition that could impair a fire fighter's ability to perform essential job tasks. They recommend restricting duty until the condition is under treatment [Somers et al. 2008; NFPA 2013a]. According to medical records, the Trainee used his CPAP only about half of the time.

Diabetes Mellitus. NFPA 1582 provides guidance for fire department physicians assessing diabetic fire fighter candidates [NFPA 2013a]. The standard states that fire fighter candidates with diabetes mellitus that is controlled by insulin should be precluded from duty unless the candidate meets all of the following criteria:

(1) Is maintained by a physician knowledgeable in current management of diabetes mellitus

(2) Has demonstrated over a period of at least 3 months the motivation and understanding required to closely monitor and control capillary blood glucose levels through nutritional therapy and insulin administration

(3) Has a dilated retinal exam by a qualified ophthalmologist or optometrist that shows no higher grade of diabetic retinopathy than microaneurysms

(4) Has normal renal function on the basis of a calculated creatinine clearance greater than 60 milliliters per minute and absence of proteinuria

(5) Has no autonomic or peripheral neuropathy

(6) Has normal cardiac function without evidence of myocardial ischemia on cardiac stress testing (to at least 12 METs) by EKG and cardiac imaging

(7) Has a signed statement and medical records from an endocrinologist or a physician with demonstrated knowledge in the current management of diabetes mellitus as well as knowledge of the essential job tasks and hazards of fire fighting, allowing the fire department physician to determine whether the candidate meets the following criteria:

(a) Is maintained on a stable insulin regimen and has demonstrated over a period of at least 3 months the motivation and understanding required to closely monitor and control capillary blood glucose levels despite varied activity schedules through nutritional therapy and insulin administration

(b) Has had hemoglobin A1C measures at least four times a year (intervals of 2-3 months) over the last 12 months prior to evaluation if the diagnosis of diabetes has been present over 1 year. A hemoglobin A1C reading of 8 percent or greater shall trigger a medical evaluation to determine if a condition exists in addition to diabetes that is responsible for the hemoglobin A1C not accurately reflecting average glucose levels.

(c) Does not have an increased risk of hypoglycemia due to alcohol use or other predisposing factors

(d) Has had no episodes of severe hypoglycemia (defined as requiring assistance of another) in the preceding 1 year, with no more than two episodes of severe hypoglycemia in the preceding 3 years

(e) Is certified not to have a medical contraindication to fire-fighting training and operations [NFPA 2013a].

The Trainee had diabetes mellitus, his diabetes was not well controlled, and he had complications of neuropathy. Therefore, according to NFPA 1582, he should have been precluded from fire fighting duties until these conditions were addressed, and additional screening tests for cardiac (exercise stress test), kidney (estimated Glomerular filtration rate), and eye (dilated eye exam) complications were performed.

Exercise Stress Tests

As mentioned above, the Trainee should have had an EST. Recommendations on whether to screen asymptomatic individuals for CHD with EST are varied. The following paragraphs summarize the positions of widely recognized organizations on this topic.

NFPA

NFPA 1582, a voluntary industry standard, recommends an EST be performed "as clinically indicated by history or symptoms" and refers the reader to Appendix A [NFPA 2013a]. 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) ESTs as a screening tool to evaluate a fire fighter's aerobic capacity. Maximal (i.e., symptom-limiting) ESTs with imaging should be used for fire fighters with the following conditions:

- abnormal screening submaximal tests
- cardiac symptoms
- known CHD
- one or more risk factors for CHD (in men older than 45 and women older than 55)
    - Hypercholesterolemia (total cholesterol greater than 240 milligrams per deciliter)
    - Hypertension (diastolic blood pressure greater than 90 mm of mercury)
    - Diabetes mellitus
    - Smoking
    - Family history of premature CHD (heart attack or sudden cardiac death in a first-degree relative less than 60 years old).
- Framingham Risk Score > 10% [NFPA 2013a; ACC/AHA 2014]

Given the Trainee's age, risk factors, and Framingham Risk Score of 11.8%, NFPA 1582 would have recommended a symptom-limiting EST.

American College of Cardiology/American Heart Association (ACC/AHA)

The ACC/AHA guideline states that the evidence to conduct stress tests in asymptomatic individuals is "less well established" (Class IIa) for those with diabetes mellitus Type II who plan to start vigorous exercise and (Class IIb) for the following groups:

- 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) [Gibbons et al. 2002].

Given the Trainee's public safety position, the ACC/AHA criteria suggest an EST would have been appropriate.

U.S. Department of Transportation

The U.S. Department of Transportation provides guidance for those seeking medical certification for a commercial driver's license. An expert medical panel recommended exercise tolerance tests (stress tests) for asymptomatic "high risk" drivers [Blumenthal et al. 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 CHD
- Framingham risk score predicting a 20% CHD event risk over the next 10 years

The Trainee was over age 45, had diabetes mellitus, and had multiple risk factors for CHD. The U.S. Department of Transportation would have recommended an EST for a commercial truck driver with a similar profile [Blumenthal et al. 2007].

U.S. Preventive Services Task Force (USPSTF)

The U.S. Preventive Services Task Force (USPSTF) does not recommend stress tests for asymptomatic individuals at low risk for CHD events. For individuals at increased risk for CHD 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, smoking, 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."

In summary, the Trainee had multiple medical conditions that should have resulted in restricted duty and prompted further medical evaluation.

Recommendations

Recommendation #1: Provide preplacement and annual medical evaluations to all fire fighters consistent with NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments, to identify fire fighters at increased risk for CHD.

Discussion: Guidance regarding the content and frequency of these medical evaluations can be found in NFPA 1582 [NFPA 2013a]. These evaluations are performed to determine fire fighters' medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others. To ensure improved health and safety of candidates and members, and to ensure continuity of medical evaluations, it is recommended the fire department comply with this recommendation. However, the fire department is not legally required to follow the NFPA standard or the Wellness/Fitness Initiative.

Applying this recommendation involves economic repercussions and may be particularly difficult for smaller fire departments to implement. However, it is likely to be cost-effective [Gaetano et al. 2007]. To overcome the financial obstacle of medical evaluations, the fire department could urge current members to get annual medical clearances from their private physicians. Another option is having the annual medical evaluations completed by paramedics and emergency medical technicians from the local ambulance service (vital signs, height, weight, visual acuity, and EKG). This information could then be provided to a community physician, perhaps volunteering his or her time, who could review the data and provide medical clearance or further evaluation, if needed. The more extensive portions of the medical evaluations could be performed by a private physician at the fire fighter's expense, by personal insurance, by a physician volunteer, or paid for by the fire department, city, or state. Sharing the financial responsibility for these evaluations between fire fighters, the fire department, the city, the state, and physician volunteers may reduce the negative financial impact on recruiting and retaining needed fire fighters.

Recommendation #2: Ensure ESTs are performed on fire fighters at increased risk for CHD.

Discussion: NFPA 1582 and the ACC/AHA recommend an EST for male fire fighters older than 45 with one or more CHD risk factors [Gibbons et al. 2002; NFPA 2013a]. The Trainee was over the age of 45 and had persistent CHD risk factors. A symptom-limiting EST may have identified his underlying CHD, possibly leading to further evaluation and treatment.

Recommendation #3: Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.

Discussion: Guidance regarding medical evaluations and examinations for structural fire fighters can be found in NFPA 1582 [NFPA 2013a]. According to these guidelines, the fire department should have an officially designated physician who is responsible for guiding, directing, and advising the members with regard to their health, fitness, and suitability for duty. The physician should review job descriptions and essential job tasks required for all fire department positions and ranks to understand the physiological and psychological demands of fire fighters and the environmental conditions under which they must perform, as well as the personal protective equipment they must wear during various types of emergency operations. It is unknown if this Trainee's personal physician was aware of NFPA 1582.

The following recommendations address general safety and health issues and would have not prevented the Trainee's death:

Recommendation #4: Perform an annual physical ability evaluation.

Discussion: NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, requires the FD to develop physical performance requirements for candidates and members who engage in emergency operations [NFPA 2013b]. Members who engage in emergency operations must be annually qualified (physical ability test) as meeting these physical performance standards for structural fire fighters [NFPA 2013b]. Once developed by the FD, this evaluation could be performed as part of the FD annual training program.

Recommendation #5: Phase in a mandatory comprehensive wellness and fitness program for fire fighters.

Discussion: Guidance for fire department wellness/fitness programs to reduce risk factors for cardiovascular disease and improve cardiovascular capacity is found in NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters, the IAFF/IAFC Fire Service Joint Labor Management Wellness/Fitness Initiative, the National Volunteer Fire Council Health and Wellness Guide, and in Firefighter Fitness: A Health and Wellness Guide [IAFF, IAFC 2008; NFPA 2008; USFA 2009; 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 [Pelletier 2009; Baicker et al. 2010]. Fire service health promotion programs have been shown to reduce coronary artery disease 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; Poston et al. 2013]. 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 et al. 2013].

The fire department does not offer a wellness/fitness program and exercise equipment is not available in the fire station. Given the fire department's structure, the National Volunteer Fire Council program would be applicable [USFA 2009]. NIOSH would recommend a formal, mandatory wellness/fitness program to ensure all members receive the benefits of a health promotion program.

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Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component in Cincinnati, Ohio. Mr. Tommy Baldwin (MS) led the investigation and co-authored the report. Mr. Baldwin is a Safety and Occupational Health Specialist, a National Association of Fire Investigators (NAFI) Certified Fire and Explosion Investigator, an International Fire Service Accreditation Congress (IFSAC) Certified Fire Officer I, and a former Fire Chief and Emergency Medical Technician. Dr. Thomas Hales (MD, MPH) provided medical consultation and co-authored 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).

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