



Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

SUMMARY

On February 23, 2004, a 55-year-old male volunteer fire fighter (FF) responded to a car fire in the garage of a residential home. Traveling in his personal vehicle, he was the first FF to arrive on-scene. While putting on his turnout gear and waiting for fire department (FD) apparatus to arrive, he watched as the fire spread to involve the entire garage and portions of the house. As other FD personnel and equipment arrived, the FF assisted the driver/operator of the first FD engine on the scene. This involved stretching a 1½-inch attack line and a 5-inch hydrant supply line while controlling water flow to the attack lines. After being on-scene for approximately 5 to 10 minutes he was asked to retrieve a pike pole from the Engine. While standing on the engine's tail board to reach the pike pole, the FF suddenly fell backward and struck his head on the concrete roadway. Witnesses stated that he did not slip or try to break his fall. They immediately assessed the FF and found him unresponsive with labored respirations and a weak pulse. While an ambulance was being requested from dispatch, other FD members retrieved the advanced life support (ALS) equipment from on-scene apparatus while another protected his cervical spine. Ambulance personnel arrived approximately 4 minutes after his collapse, and found the FF to be in ventricular fibrillation (a heart rate incompatible with life). Despite defibrillation numerous times at the scene, in the ambulance, and at the emergency department (ED), resuscitation efforts failed to revive the FF.

The death certificate and autopsy, both completed by a forensic pathologist (the deputy county coroner), listed “arteriosclerotic and hypertensive

heart disease” as the immediate cause of death with “morbid obesity” as a contributory condition. The physical stress of responding to the residential house fire and assisting with operator duties coupled with his underlying atherosclerotic coronary artery disease contributed to this fire fighter's sudden cardiac death.

The first five recommendations are preventive measures recommended by other fire service groups to reduce, among other things, the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. The last two recommendations, while only indirectly related to this fatality, raise potential safety issues that may be encountered by this FD.

- ***Provide mandatory preplacement medical evaluations to ALL fire fighters to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.***
- ***Provide annual medical evaluations for all members.***

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. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. 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 www.cdc.gov/niosh/firehome.html or call toll free **1-800-35-NIOSH**

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

- *When appropriate, incorporate exercise stress tests (EST) into the annual medical evaluations for fire fighters with multiple risk factors for coronary artery disease (CAD).*
 - *Clear fire fighters for duty and for respirator use though 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, the National Fire Protection Association’s Standard on Comprehensive Occupational Medical Program for Fire Departments.*
 - *Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*
 - *Consider annual respirator fit testing.*
 - *Provide adequate fire fighter staffing to ensure safe operating conditions.*
- Fire Chief
 - Local Union President
 - Crew members at the incident with the deceased FF
 - Deceased FF’s sister

During the site visit and subsequently, the NIOSH physician reviewed the following documents:

- FD operating guidelines
- FD witness statements
- FD report of this incident
- Ambulance response report
- Hospital ED records of this incident
- FF’s medical records
- Death certificate
- Autopsy report

INVESTIGATIVE RESULTS

Incident. On February 23, 2004, the volunteer FF had just completed an 8-hour workday at the City’s Road Division. As he pulled into his driveway at 1611 hours, he heard the emergency radio scanner in his vehicle assign Engine 35 and Rescue 34 to a car fire in a residential garage. Since the FF had his personal protective gear in his car and the fire was near his home, the FF immediately responded to the incident in his personal vehicle. A police unit arrived on-scene first, assisted the residents out of the home, and confirmed that no additional civilians were in the home. The FF arrived at approximately 1613 hours. As he waited for FD apparatus to arrive, he put on his turnout coat, turnout pants, rubber knee boots, protective hood, and leather gloves.

Engine 35 arrived on-scene at 1615 hours and initial size-up revealed heavy smoke and flames coming from an open garage door of a split level wood frame residential home. At 1617 hours Engine 35 radioed dispatch to put out an “all call” alerting all members of the FD to respond to the

INTRODUCTION AND METHODS

On February 23, 2004, a 55-year-old male volunteer fire fighter (FF) died after collapsing at the scene of a residential fire. On February 24, 2004, the United States Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of the death. On March 4, 2004, NIOSH contacted the affected fire department (FD) to initiate the investigation. On November 24, 2004, a NIOSH physician traveled to Ohio to conduct an on-site investigation of the incident.

During the investigation the NIOSH physician interviewed the following people:

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

incident as well as neighboring FD's participating in a mutual aid program. At 1618 hours Rescue 34 arrived and shortly thereafter, the Fire Chief (FC) arrived and assumed incident command.

The FF was assigned as an assistant to the Driver/Operator (D/O) of Engine 35. This involved stretching a 1½-inch attack line and a 5-inch hydrant supply line while controlling water flow to the attack lines. While stretching the 1½-inch hose line the first on-scene police officer saw the FF trip on one of the hoses. When the police officer asked if the FF was all right he responded that he was fine.

After being on-scene for approximately 5 to 10 minutes, the FF was asked to retrieve a pike pole from the top of Engine 35. While standing on the Engine 35's tailboard reaching for the pike pole, the FF suddenly bent forward, wrapping his arms around his waist. Another volunteer fire fighter witnessed this event and asked if everything was all right. He received no response. The FF then stood upright and fell backward off the truck. He did not appear to slip and while falling he made no attempt to cushion his fall. He landed on his back and then his head snapped backwards striking his skull on the concrete street.

Initial evaluation by the volunteer fire fighter who witnessed the fall and the D/O of Engine 35 found the FF unresponsive with labored respirations and a weak pulse. At 1625 hours the D/O of Engine 35 radioed dispatch from Engine 35 requesting an ambulance for a downed fire fighter. Other members of the FD then retrieved advanced life support (ALS) equipment from Rescue 34 while another protected the FF's cervical spine. At approximately 1627 hours, on-scene FD paramedics and emergency medical technicians (EMTs) reassessed the FF and found him to be

unresponsive with no respirations, and no pulse. Blood was coming out of his nose and mouth and his right eye was very swollen. An oral airway was inserted and oxygen was started (15 liters per minute) by bag valve mask.

The private ambulance service arrived at 1629 hours. They also found the FF to be unresponsive with no respirations, no pulse, and fixed and dilated pupils. A quick look on the cardiac monitor showed ventricular fibrillation (VFib). He was defibrillated once at 200 joules without a change in his heart rhythm. A second defibrillation of 300 joules was delivered which resulted in asystole (no heart beat). Cardiopulmonary resuscitation (CPR) ensued followed by placement of an endotracheal tube on the second attempt with placement confirmation by auscultation. He was "bagged" with 100% oxygen. At this point the FF's heart rhythm returned to VFib and a third defibrillation attempt of 360 joules was delivered. Again his heart rate converted to asystole. His cervical spine was stabilized and an intravenous (IV) line was attempted but not successful prior to the ambulance departing the scene at 1644 hours.

While en route to the hospital's emergency department (ED) ambulance paramedics continued CPR and again attempted unsuccessfully to place an IV line. Without IV line, atropine and epinephrine (ALS medications) were delivered down the endotracheal tube. In addition, the FF's heart rhythm returned to VFib and a fourth, unsuccessful, defibrillation of 360 joules was delivered.

According to the ED, the ambulance arrived at 1648 hours; the ambulance report states 1657 hours. In either case, in the ED the endotracheal tube placement was confirmed by a CO₂ monitor, severe head trauma was noted, and CPR/ALS

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

continued for 5 minutes after which he was pronounced dead and resuscitation efforts were discontinued. The time of death recorded on the death certificate was 1653 hours.

Medical Findings. The death certificate and autopsy were completed by the forensic pathologist in the county coroner's office. Both listed "arteriosclerotic and hypertensive heart disease" as the immediate cause of death with "morbid obesity" as a contributory condition. Significant findings listed in the autopsy report included the following:

1. Coronary artery disease (CAD)
 - Atherosclerotic occlusions of the native coronary arteries (remote)
 - Two vessel coronary artery bypass graft procedure (remote)
 - Occlusion of the lower coronary artery bypass graft (remote)
 - Open upper coronary artery bypass graft but with moderate calcific atherosclerosis
 - Myocardial infarct (heart attack) involving the anterior left ventricle and interventricular septum (remote)
2. Cardiomegaly (enlarged heart) weighing 780 grams (normal < 400 grams)¹
3. Mild narrowing of the arteries leading to the kidneys (arteriolonephrosclerosis), which is consistent with the diagnosis of hypertension.
4. Morbid obesity; at 72 inches tall, the FF weighed 300 pounds for a body mass index (BMI) of 40.7. A BMI > 40.0 is defined as Class III or extreme obesity.²
5. A carboxyhemoglobin (COHb) measurement of <5% saturation. (Since the FF did not regain

a heartbeat during resuscitation efforts, the 100% oxygen delivered via the endotracheal tube was unlikely to have significantly reduced the half-time of his COHb level. Thus, a level of <5% is unlikely to have contributed to his sudden death.)

6. Negative urine drug screen
7. Skull fractures

The deceased fire fighter had several CAD risk factors: hypertension, hypercholesterolemia, family history, obesity, age, and male gender. In September 1992, the FF sought medical attention for chest tightness and shortness of breath. A resting electrocardiogram (EKG) showed a heart conduction problem (right bundle branch block – RBBB). To further evaluate these symptoms a thallium exercise stress test (EST) was conducted using the Bruce protocol. The FF exercised for 6 minutes reaching 90% of his target heart rate before stopping secondary to fatigue. He reported no chest pain and had no heart arrhythmias. However, the rise in systolic blood pressure that normally accompanies exercise did not occur, and his EKG tracings were non-diagnostic since the RBBB interferes with the seeing ischemic changes. The thallium scan showed a large old heart attack (fixed defect in the apical, lateral, and inferior wall) with some areas of the heart still at risk for another heart attack (some reversible perfusion in the lateral and inferior wall). To confirm the diagnosis and evaluate treatment options, the FF underwent a cardiac catheterization that showed severe blockage of his three main coronary arteries and severe impairment of his heart function (left ventricular ejection fraction [LVEF] of 20%–25%). A normal LVEF is generally considered > 50%.³ In November 1992, the FF underwent successful coronary artery bypass surgery.

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

After cardiac rehabilitation, the FF was lost to cardiology follow-up until July 2001 when he sought medical attention for a rapid, pounding heartbeat. He was found to have atrial fibrillation (a type of heart arrhythmia). Subsequent work-up included a chemical (adenosine), rather than exercise, stress test due to his obesity and inability to walk/run on the treadmill. After being given the adenosine infusion, his heart rate did not increase significantly (63 beats per minute to 73 beats per minute) due to prescription medications (beta-blockers) used to suppress his rapid heart beat. His systolic blood pressure rose slightly, he reported no angina, and his EKG still showed RBBB but no arrhythmias. The thallium scan showed no areas at risk for a heart attack (e.g., no reversible component).

An echocardiogram later that year showed an enlarged left atrium, mild mitral valve regurgitation, and moderate to severe impairment of heart function (left ventricular ejection fraction [LVEF] 30%–35%).

The FF's last cardiology office visit was in March 2003 for a routine follow-up. At that time the FF had no new complaints, and an EKG showed no changes from 2001. At that time he was noted to have new right carotid artery bruits (sounds suggesting a narrowing of the neck arteries providing blood to the head). Subsequent work-up with an ultrasound showed "possible distal occlusion of the left carotid system." His last primary care physician office visit was in July 2003 for routine follow-up. Again, the FF voiced no complaints.

The fire fighter had worked for the town's road division. The day of his death he just completed an 8-hour shift during which time he directed traffic and drove/operated roadway trucks. This would be considered light physical work. At

no time during that shift did he mention any symptoms suggesting an exacerbation of this underlying cardiac condition.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the site visit, the FD had 17 career, 5 part-time, and 7 volunteer fire fighters for a roster of 29 fire fighters. The career FFs are represented by the International Association of Fire Fighters (IAFF). The Department serves a township of 16.7 square miles with a population of 13,000. There are two fire stations. In 2003, the FD responded to 1774 incidents of which 84 (5%) were structural, vehicle, or grass fires. The FD also operates an ambulance service housed at one of its fire stations. The ambulance is staffed by career FD personnel all of whom are either paramedics or certified EMT-Ds. The career fire fighters work what they term a "Buffalo Shift" of: 24-on, 48-off, 24-on, 48-off, 24-on, 72-off, 24-on, 48-off, 24-on, 48-off, 24-on, 6 days off.

Hiring Procedure. When a career FF vacancy becomes available, the township advertises the position. Applicants must be between the ages of 18 and 40 and hold a current State drivers license. While the FD does not require the applicant to already be a fire fighter or an EMT, these certifications are given significant weight in the ranking process. A general knowledge civil service test is administered followed by a pass/fail physical ability test (described below). Prior to taking the physical ability test, a medical release from the applicant's private physician must be obtained. This medical release requires a physical examination and clears the applicant to participate "in a moderately vigorous physical fitness evaluation program." The candidates are ranked by score and the top ten candidates per position are interviewed by the Fire Chief who

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

also conducts a background check. From these ten, the top three are forwarded to the Township Board of Trustees for interviews. The Board selects and hires the candidate who becomes a probationary employee for a year. Before starting work, however, the probationary FF must complete an Ohio Police and Fire Pension Board medical examination (described below) and a drug test administered by the Township.

Part-time FFs (those who work less than 48 hours a week and receive no benefits) become members by an abbreviated hiring process. Applications are submitted directly to the Fire Chief and are limited to paramedics and Level II FF (NFPA certified). The Fire Chief reviews the application and conducts a background investigation and then makes a recommendation to the Township Board of Trustees. After interviewing the applicant, the Board makes the final hiring decision. Part-time FFs are not required to pass a physical ability or medical clearance process. After being hired, the part-time FF must also pass a drug test administered by the Township.

Since the new Fire Chief was hired in 2002, the FD has been transitioning from a combination FD to an all career department. Thus, since 2002 the FD has not recruited or accepted new volunteers. The seven volunteer members joined the FD prior to 2002 and have been “grandfathered” in. The deceased FF was a volunteer who joined the FD in May 1991. At that time the FD did not require medical clearance for volunteers.

Medical Evaluations. Although the probationary employee can select the physician to conduct the pre-placement medical evaluation, the content is dictated by the Ohio’s Police and Fire Pension Board. This evaluation is conducted on all probationary employees, regardless of age. Components of the evaluation include the following:

- A complete medical history (medical, occupational, family)
- Physical examination
- Vital signs
- Vision screening (acuity and color)
- Hearing screen (whisper test)
- Blood analysis: lipid panel, and hepatitis C antibody titer
- Chest x-ray (at least a posterior-anterior view read by a radiologist)
- 12-lead resting electrocardiogram (EKG)
- Bruce protocol exercise stress test (EST)
- Pulmonary function test (spirometry)
- Skin test for tuberculosis (PPD)

After reviewing the above information, the examining physician makes a determination regarding fitness for duty. A separate medical clearance is not required for wearing a respirator including a self-contained breathing apparatus (SCBA). No medical evaluation or medical clearance is required for part-time employees and volunteers.

Periodic Medical Evaluations.

No periodic medical evaluations are required for career, part-time, or volunteer fire fighters. However, in 2005 the FD will receive federal funding through a Fire Act Grant to begin a wellness program. This program will include annual medical evaluation. Currently, the FD has exercise/fitness equipment available at both stations, but no formal fitness program.

The Fire Chief can limit or restrict the duties of members unable to perform a full range of duties due to health problems or age. If members miss three or more shifts due to injury or illness (either work-related or not), they are required to get a physician’s clearance to return to duty. In December 2003, the Fire Chief noted the FF was having difficulty donning his SCBA during a fire

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

response. Subsequently, the Fire Chief and the FF agreed to restrict his fire suppression activities to engine operation.

DISCUSSION

Coronary Artery Disease (CAD) and the Pathophysiology of Sudden Cardiac Death

In the United States, coronary artery disease (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death.⁴ Risk factors for CAD development include increasing age, male gender, heredity, tobacco use (smoking), high blood cholesterol, high blood pressure, physical inactivity, obesity/overweight, and diabetes.⁵ The FF had several of these risk factors and was found to have severe CAD in 1993, leading to his bypass surgery.

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.⁶ However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.⁷ 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.⁸ This sudden blockage is primarily due to blood clots (thrombosis) forming on top of atherosclerotic plaques. On autopsy, the deceased FF was noted to have remote (old) occlusions but no evidence of a recent (acute) thrombosis.

Given his lack of a coronary artery thrombus, the FF's sudden death was probably due to a heart arrhythmia associated with his underlying heart disease (atherosclerotic coronary artery disease and congestive heart failure) triggered by his moderate exertion on the fire ground. On the other hand, not all heart attacks are associated with coronary artery thrombus. Other tests used to confirm a heart attack such as blood tests (cardiac

isoenzymes) or EKG findings were not helpful in this case because the FF died prior to cardiac isoenzymes becoming positive, and he had no heart beat to show the characteristic findings of a heart attack on the EKG. Since up to 20% of heart attacks are silent (i.e., no angina),⁹ the lack of symptoms in this FF cannot definitively rule out another myocardial infarction.

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 to persist through the course of fire suppression activities.¹⁰⁻¹³ Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.¹⁴⁻¹⁸ The fire fighter drove his vehicle to the fire scene and engaged in moderate physical exertion while assisting Engine 35's Driver/Operator. This physical exertion coupled with his underlying atherosclerotic coronary artery disease contributed to this fire fighter's sudden cardiac death.

Should this fire fighter have been cleared to participate in fire suppression activities? This question has two parts. First, did the fire fighter have the physical capacity to engage in fire suppression? Two months prior to his death, the Fire Chief noted the FF's difficulty with donning and doffing his SCBA equipment and appropriately restricted his duties to operating the engine, where SCBA use was not required.

The second part of the question is whether the fire fighter should have been medically cleared for fire suppression. None of the personal physician records provided to NIOSH indicated that the FF ever sought medical clearance to work as a volunteer fire fighter. Fire fighters work in environments immediately dangerous to life

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

and health (IDLH). Therefore, if fire fighters become suddenly incapacitated, not only are their own lives endangered, but also those of their peers and the civilians they have sworn to protect. To assist physicians making these clearance decisions, the NFPA developed 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.¹⁹ The FF had several cardiac conditions that should have precluded him from engaging in unrestricted fire suppression duties. Ironically, the FF was already placed on physical, not medical, restricted duty 3 months prior to his death. It is unclear if more restrictive fire ground duties could have prevented his unfortunate sudden cardiac death.

RECOMMENDATIONS

The first five recommendations are preventive measures recommended by other fire service groups to reduce, among other things, the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. The last two recommendations, while only indirectly related to this fatality, raise potential safety issues that may be encountered by this FD. These recommendations are listed in order of priority.

Recommendation #1: Provide mandatory preplacement medical evaluations to ALL fire fighters to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

The FD currently requires preplacement medical evaluations for career, but not volunteer fire fighters. We recommend the FD extend this mandatory evaluation to volunteers. The content of this medical evaluation is currently determined by the State Police and Fire Pension fund. I concur on all aspects of this comprehensive evaluation

except for one component, the EST. Due to false positive tests, particularly among young individuals, the American Heart Association/American College of Cardiology (AHA/ACC) does not recommend EST in asymptomatic individuals without known CAD.²⁰ However, the AHA/ACC also states that for individuals involved in public safety occupations (e.g., fire fighters), EST can be considered for men above the age of 45 and women above the age of 55.²⁰

Recommendation #2: Provide annual medical evaluations for all members.

NFPA 1582 recommends an annual fire fighter medical evaluation. We recommend the FD negotiate with the fire fighter's union to determine the content and frequency of this evaluation. Example programs to consider include NFPA 1582, *Standard on Comprehensive Occupational Medical Programs for Fire Departments*, and the wellness/fitness initiative produced by the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC).²¹ However, the FD is not legally required to follow any of these standards.

In addition to providing guidance on the frequency and content of the medical evaluation, NFPA 1582 provides guidance on medical requirements for persons performing fire fighting tasks. NFPA 1582 should be applied in a **confidential, nondiscriminatory** manner. Appendix D of NFPA 1582 provides guidance for Fire Department Administrators regarding legal considerations in applying the standard.

Applying NFPA 1582 also involves economic issues. These economic concerns go beyond the costs of administering the medical program; they involve the personal and economic costs of dealing with the medical evaluation results. NFPA

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

1500, Standard on Fire Department Occupational Safety and Health Program, addresses these issues in Chapter 8-7.1 and 8-7.2.²²

The success of medical programs hinges on protecting the affected fire fighter. The FD must 1) keep the medical records confidential, 2) provide alternate duty positions for fire fighters in rehabilitation programs, and 3) if the fire fighter is not medically qualified to return to active fire fighting duties, provide permanent alternate duty positions or other supportive and/or compensated alternatives.

Recommendation #3: When appropriate, incorporate exercise stress tests (EST) into the annual medical evaluations for fire fighters with multiple risk factors for CAD.

As mentioned earlier, the AHA/ACC suggests EST should be considered for male fire fighters above the age of 45 and female fire fighters above the age of 55. This is particularly important if the FF has diabetes mellitus and a sedentary lifestyle, or if the fire fighter has multiple risk factors for CAD.²⁰ The AHA/ACC defines multiple risk factors as follows:

- family history a heart attack or sudden cardiac death in a first degree relative less than 60 years old
- hypertension (systolic blood pressure > 140 mmHg or diastolic blood pressure >90 mm Hg)
- hypercholesterolemia (total cholesterol greater than 240 mg/dL or HDL cholesterol less than 35 mg/dL)
- cigarette smoking
- diabetes mellitus

Recommendation #4: Clear fire fighters for duty and for respirator use through 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, the National Fire Protection Association's Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians.

The decision regarding medical clearance for fire fighters requires knowledge not only of the fire fighter's medical condition, but also of the fire fighter's job duties and NFPA 1582 medical fitness criteria. These clearance decisions should be made not only during the preplacement and annual medical evaluations, but whenever fire fighters suffer an on- or off-the-job injury or illness affecting their job performance.

Recommendation #5: Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.²² The International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) joined in a comprehensive Fire Service Joint Labor Management Wellness/Fitness Initiative to improve fire fighter quality of life and maintain physical and mental capabilities of fire fighters. Ten fire departments across the United States joined this effort to pool information about their physical fitness programs and to create a practical fire service program. They produced a manual and a video detailing elements of such a program.²¹ The Wellness/Fitness Initiative provides guidance regarding wellness program content to include physical examination and evaluation, fitness,

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

and behavioral health. Wellness programs have been shown to be cost-effective, typically by reducing the number of work-related injuries and lost work days.^{23,24} An unpublished analysis by the Phoenix, Arizona city auditor found a reduction in disability pension costs following a 12-year commitment to the wellness program at the Fire Department. Small FDs, such as yours should review the programs mentioned above and determine which components are practical for them. Your application for and acceptance of a Fire Act Grant for a Fitness/Wellness program shows your commitment to providing this program to the City and its fire fighters.

Recommendation #6: Consider annual respirator fit testing.

The Occupational Safety and Health Administration (OSHA) respiratory protection standard requires employers whose employees are required to use respirators to have a formal respiratory protection program, including annual fit testing.²⁵ Since Ohio does not have an OSHA-approved State plan, public employers, including volunteer or career fire departments, are not legally subject to OSHA standards.²⁶ Nevertheless, we recommend that the FD voluntarily follow the health and safety related provisions of the OSHA standard, including annual fit testing.

Recommendation #7: Provide adequate fire fighter staffing to ensure safe operating conditions.

NFPA 1710 requires that “on-duty personnel assigned to fire suppression shall be organized into company units and shall have appropriate apparatus and equipment assigned to such companies.”²⁷ Those companies may respond with two apparatus, depending on the seating configuration of the apparatus to ensure that

four personnel arrive on-scene. Personnel assigned to the initial arriving company shall have the capability to implement an initial rapid intervention crew, which requires four personnel (two to enter the structure and two standing by outside). NFPA 1500 recommends that “members operating in hazardous areas at emergency incidents shall operate in teams of two or more.”²²

REFERENCES

1. Siegel RJ [1997]. Myocardial Hypertrophy. In: S. Bloom (ed). Diagnostic Criteria for Cardiovascular Pathology Acquired Diseases. Philadelphia, PA: Lippencott-Raven, pp. 55-7.
2. World Health Organization. Obesity: Preventing and Managing the Global Obesity Epidemic. Report of WHO Consultation of Obesity. June 3-5, 1997.
3. Little WC [2001]. Chapter 15: Assessment of normal and abnormal cardiac function. In: Braunwald E, Zipes DP, Libby P, eds. Heart Disease. A Textbook of Cardiovascular Medicine. 6th ed. New York: WB Saunders Company, pp. 479-502.
4. Meyerburg RJ, Castellanos A [2001]. Cardiovascular collapse, cardiac arrest, and sudden cardiac death. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, eds. Harrison’s principles of internal medicine. 15th ed. New York: McGraw Hill, pp. 228-233.
5. American Heart Association. Risk factors and coronary heart disease (AHA scientific position). Available at Accessed May 2002.
6. Libby P [2001]. The pathogenesis of atherosclerosis. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL,

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

- eds. Harrison's principles of internal medicine. 15th ed. New York: McGraw Hill, pp. 1377-1382.
7. Shah PK [1997]. Plaque disruption and coronary thrombosis: new insight into pathogenesis and prevention. *Clin Cardiol* 20 Suppl II:38-44.
8. Fuster V, Badimon JJ, Badimon JH [1992]. The pathogenesis of coronary artery disease and the acute coronary syndromes. *N Eng J Med* 326: 242-250.
9. Selwyn AP, Braunwald E [2001]. Ischemic heart disease. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, eds. Harrison's principles of internal medicine. 15th ed. New York: McGraw-Hill, pp. 1399-1410.
10. Gledhill N, Jamnik, VK [1992]. Characterization of the physical demands of firefighting. *Can J Sport Sci* 17:207-213.
11. Barnard RJ, Duncan HW [1975]. Heart rate and ECG responses of fire fighters. *J Occup Med* 17:247-250.
12. Manning JE, Griggs TR [1983]. Heart rate in fire fighters using light and heavy breathing equipment: simulated near maximal exertion in response to multiple work load conditions. *J Occup Med* 25:215-218.
13. Lemon PW, Hermiston RT [1977]. The human energy cost of fire fighting. *J Occup Med* 19:558-562.
14. Willich SN, Lewis M, Lowel H, et al. [1993]. Physical exertion as a trigger of acute myocardial infarction. *N Eng J Med* 329:1684-1690.
15. Mittleman MA, Maclure M, Tofler GH, et al. [1993]. Triggering of acute myocardial infarction by heavy physical exertion. *N Eng J Med* 329: 1677-1683.
16. Siscovick DS, Weiss NS, Fletcher RH, Lasky T [1984]. The incidence of primary cardiac arrest during vigorous exercise. *N Eng J Med* 311:874-877.
17. Tofler GH, Muller JE, Stone PH, et al. [1992]. Modifiers of timing and possible triggers of acute myocardial infarction in the thrombolysis in myocardial infarction phase II (TIMI II) study group. *J Am Coll Cardiol* 20:1049-1055.
18. Albert CM, Mittleman MA, Chae CU, et al. [2000]. Triggering of sudden death for cardiac causes by vigorous exercise. *N Eng J Med* 343: 1555-1561.
19. NFPA [2003]. NFPA 1582, Standard on comprehensive occupational medicine programs for fire departments. Quincy, MA: National Fire Protection Association.
20. American College of Cardiology/American Heart Association [2002]. ACC/AHA 2002 guideline update for exercise testing: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Gibbons RJ, Balady GJ, Bricker JT, et al., eds. Bethesda, MD.
21. IAFF [2000]. The fire service joint labor management wellness/fitness initiative. Washington, D.C.: International Association of Fire Fighters, Department of Occupational Health and Safety.
22. NFPA [1997]. NFPA 1500, standard on fire department occupational safety and health

Fire Fighter Collapses and Dies While Assisting with Fire Suppression Efforts at a Residential Fire – Ohio

- program. Quincy, MA: National Fire Protection Association.
23. Maniscalco P, Lane R, Welke M, Mitchell J, Husting L [1999]. Decreased rate of back injuries through a wellness program for offshore petroleum employees. *J Occup Environ Med* 41:813-820.
24. Stein AD, Shakour SK, Zuidema RA [2000]. Financial incentives, participation in employer sponsored health promotion, and changes in employee health and productivity: HealthPlus health quotient program. *J Occup Environ Med* 42:1148-1155.
25. 42 CFR 1910.134. Available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716&p_text_version=FALSE. Accessed Dec 2004.
26. OSHA [2004]. State Occupational Safety and Health Plans. <http://www.osha.gov/fso/osp/index.html> Accessed Dec 2004.
27. NFPA [2004]. NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments. Quincy, MA: National Fire Protection Association.

INVESTIGATOR INFORMATION

This investigation was conducted by, and the report written by Thomas Hales, MD, MPH. Dr. Hales coordinates the Cardiovascular Disease Component of the NIOSH Fire Fighter Fatality Investigation and Prevention Program located in Cincinnati, Ohio.

U. S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
4676 Columbia Parkway, MS C-13
Cincinnati, OH 45226-1998

OFFICIAL BUSINESS

Penalty for private use \$300



**Delivering on the Nation's promise:
Safety and health at work for all people
through research and prevention**