



NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation

October 18, 2004

Fire Fighter-Engineer Suffers Sudden Cardiac Death While Performing Strenuous Fire Station Maintenance – California

SUMMARY

On February 1, 2003, a 52 year-old male career Fire Fighter-Engineer (FF-E) was conducting trail maintenance behind his duty station (Station 18). The portion of the trail he was maintaining was very steep, approximately a 20% grade for a ¼ mile, and served a variety of Fire Department (FD) functions including a jogging path for physical training by FD members. The wild grasses of 1-2 feet high were encroaching on the trail, and the FF-E and his crewmember were cutting the grass using a lawn mower. After cutting the grass up the hill and starting back down, the FF-E suddenly collapsed. The collapse was witnessed by a crew member who ran up the hill to assist the FF-E. He noted the FF-E was unresponsive and not breathing. At 0900 hours the crewmember notified dispatch of a “fire fighter down” and “possible code blue” as he started cardiopulmonary resuscitation (CPR). Station 18’s Captain retrieved the Engine’s automated external defibrillator (AED) and shocked the FF-E twice without a successful change in the FF-E’s heart rhythm. Nineteen minutes later, other advanced life support (ALS) units began to arrive at the fire station and resuscitation efforts continued for an additional 25 minutes before departing for the nearest hospital. CPR and ALS continued for the 20 minute transport and for a few minutes in the Emergency Department (ED), before the FF-E was pronounced dead by the ED physician. The death certificate and autopsy, completed and performed by a pathologist with the County’s Coroner’s Bureau, listed “atherosclerotic coronary artery disease” as the immediate cause of death with “hypertension” listed as another significant condition. The physical stress of pulling the lawn mower up the hill and his underlying atherosclerotic coronary artery disease contributed to this fire fighter’s cardiac arrest and sudden death.

The first recommendation below addresses a safety issue specific to this event. The next two recommendations are preventive measures recommended by other fire service groups to reduce the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. The final recommendation addresses a potential safety issue unrelated to this particular event.

- *Consider some other method of cutting the grass on the steep hill behind Station 18.*
- *Provide annual medical evaluations to 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 and the local Union should negotiate to phase-in a mandatory fitness and wellness program consistent with NFPA 1583 and/or the Fire Service Joint Labor Management Wellness/Fitness Initiative.*

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



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- ***Following an injury/illness, the final determination of a fire fighter's return-to-work status should be made by the fire department physician who is knowledgeable about the physical demands of fire fighting, the medical requirements of fire fighters, and the various components of NFPA 1582.***

INTRODUCTION & METHODS

On February 1, 2003, a 52 year-old male Fire Fighter-Engineer was performing some strenuous fire station maintenance when he suddenly collapsed. Despite CPR and ALS treatment at the scene, in the ambulance, and at the hospital's ED, the FF-E died. NIOSH was notified of this fatality on February 5, 2003, by the United States Fire Administration. NIOSH contacted the affected FD on February 13, 2003, to obtain further information. On August 30, 2004, an Occupational Physician from the NIOSH Fire Fighter Fatality Investigation Team traveled to California to conduct an on-site investigation of the incident.

During the investigation NIOSH personnel met and/or interviewed the:

- Deputy Fire Chief
- Training Division Chief
- Crew member on-duty with the FF-E
- Friends of the FF-E who were also members of the FD
- FD Physician

During the site-visit NIOSH personnel reviewed:

- FD policies and operating guidelines
- FD training records
- FD annual report for 2003
- FD incident reports
- Witness statements of the incident
- FD physical examination protocols
- FD Medic report
- Death certificate
- Autopsy report

INVESTIGATIVE RESULTS

On February 1, 2003, the FF-E arrived at his fire station at approximately 0715 hours for his 24 hour tour of duty which began at 0800 hours. During the shift change departing crew members had breakfast with arriving crew members. After the breakfast dishes were cleaned, crew members were typically allowed one hour of "protected," but not out-of-service, physical fitness training (PT) time. During the FF-E's PT time, he typically walked/jogged a dirt trail that began at the entrance to the fire station, proceeded along the station's driveway for about ½ mile, and then climbed a very steep hill (20% grade) for a ¼ mile behind the station. The FF-E would typically walk/jog this 0.7 mile trail several times during his PT time.

During the winter/wet season, the native grasses would climb up to two feet high and encroach upon the ¼ mile trail up the hill. To maintain the trail, the FD cut back these grasses several times a season using a 35-40 pound lawn mower. On the morning of February 1, 2003, the FF-E and his FF crewmember decided it was time to cut the wild grasses. After starting the engine, the FF-E pulled the lawn mower up the hill using a harness around his chest, while the other FF pushed from it below. It took this team approximately 20 minutes to reach the top of the ¼ mile hill, cutting a swath of grass as they climbed. Upon reaching the top of the hill both members were short of breath, but the FF-E never expressed any symptoms of angina. The two rested for a few minutes, and then started back down the hill.

The crewmember was guiding the mower down the trail while the FF-E lagged a little behind. Approximately half way down the hill, the FF turned around and noted the FF-E had just collapsed. The FF quickly ran up the hill and found the FF-E unresponsive. As he rolled the FF-E over onto his back, the FF-E had two agonal respirations (0900



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hours). The FF called dispatch using the FF-E's radio stating "fire fighter down, possible code blue." Further assessment revealed the FF-E had no pulse or spontaneous respirations. At this point the FF began CPR and requested a Medivac helicopter from dispatch.

Station 18's Captain was conducting his own PT on exercise equipment inside the station when he either saw or heard the commotion outside. He heard the radio dispatch and grabbed the Engine's medical bag including the AED and he started up the hill. Upon reaching the FF-E he attached the AED leads and the AED advised, and administered, two shocks without successfully converting the FF-E's heart rhythm. He then inserted an oral airway, gave oxygen, and provided mechanical ventilation using a bag-valve-mask. During the resuscitation efforts some pinkish material needed to be repeatedly cleared from the FF-E's mouth. This material was reported to be Pepto-Bismo,[®] an over-the-counter medication for indigestion or heartburn.

The first apparatus to reach Station 18 was the private ambulance service's supervisor at 0919 hours, followed seconds later by Engine-31 equipped with ALS gear and a paramedic. Engine-31's team was the first to actually reach the FF-E due to his location up the hill. After taking report from Station 18 crewmembers, repeat assessment revealed the FF-E had no pulse or spontaneous respirations. The heart monitor leads were checked and a heart rhythm of asystole (no heart beat) was confirmed. E-31's paramedic attempted to intubate the FF-E (inserting a breathing tube into the windpipe) but was unsuccessful due to the awkward position on the hillside. The FF-E was repositioned and the next intubation attempt was successful with placement confirmed by both auscultation and secondary objective methods as required by the American Heart Association (AHA).¹

During this time additional dispatched personnel were arriving on-scene which included the private ambulance company (0921 hours), Medic 51 (0923 hours), Engine-14 (0923 hours), and Battalion Chief (BC)-510 (0925 hours) for a total of 14 FD and ambulance response personnel. These FF and paramedics took over the CPR duties from Station 18's crew members, as well as the additional ALS procedures (intravenous line established and medications delivered).

A privately owned four-wheel drive truck was driven up the hill to carry the FF-E down the hill to the waiting ambulance. At this point the responding BC had contact with the Medivac helicopter who stated they were still several minutes away. After consulting with E-14's and other paramedics familiar with the time required to land, load, and transfer care of patients onto the helicopter, the BC made the decision to cancel the helicopter and transport the FF-E via ground ambulance. At 0944 hours, the ambulance departed the scene with two ambulance paramedics and two FD paramedics bound for the hospital's ED. Enroute CPR and ALS care was continued without a change in patient status (he remained in asystole).

The ambulance arrived at the hospital ED at approximately 1000 hours. Up to this point the FF-E had received BLS care for approximately 19 minutes, and ALS care for approximately 39 minutes. ALS procedures were continued in the ED for a few more minutes, before the FF-E was pronounced dead by the ED physician at 1002 hours. At this point, resuscitation measures were discontinued.

Medical Findings. The death certificate completed by the ED physician, and the autopsy completed by the County's forensic pathologist both listed "atherosclerotic coronary artery disease" as the immediate cause of death with "hypertension" as another significant condition. Pertinent findings from the autopsy included:



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- Cardiomegaly (an enlarged heart) weighing 510 grams (upper limit of normal is 400 grams)
- Moderate biventricular dilatation (LV - 4 centimeters (cm) internal diameter; RV- 4.0 X 4.5 cm internal diameter)
- Atherosclerotic coronary artery disease
 - 75% stenosis of the right coronary artery with a right dominant coronary artery system
 - 75% stenosis in the left main artery
 - 90% stenosis in the left anterior descending artery
 - 90% stenosis in the left circumflex artery
 - No coronary artery thrombus (blood clot)
- No pulmonary emboli (blood clot in the lung vasculature)
- Negative drug screen

The FF-E had a history of hypertension (high blood pressure) and hyperlipidemia (high blood cholesterol and triglycerides) since at least 1991. His hypertension was under fair control by a prescription medication with variable compliance. His hyperlipidemia was not well controlled by diet and exercise. His last FD physical examination in February 2002 revealed a height of 75 inches and a weight of 224 pounds giving him a body mass index (BMI) of 28 kilograms per square meter (kg/m²). (A BMI between 25 and 29.9 kg/m² is considered overweight).²

According to the FF-E's mother and FD personnel, the FF-E walked, jogged, biked, swam, and played golf and tennis on a regular basis. His most recent fitness/stress test was performed on cycle ergometer by the FD's contract physician in February 2002. The FF-E exercised for seven minutes before reaching his target heart rate of 151 beats per minute [the target heart rate was 90% of his maximal heart rate (220-age)]. His calculated MVO₂ was 32 milliliters per kilogram per minute (ml/kg/min) which was labeled "average." An MVO₂ of 32 mg/kg/min is equivalent to approximately nine METS (metabolic

equivalents). The FF-E did not have any symptoms of angina, did not have any arrhythmias, and had a good blood pressure response. However, his electrocardiogram (EKG) showed some new (since his last test in 2000) ST segment depressions (2-4 millimeters) in some (V4-V6) precordial leads at peak exercise which resolved within one minute during the recovery period. The ST segment depression suggests a positive stress test for ischemic heart disease (IHD). On the other hand, most of these ST segments had an upsloping pattern which is less suggestive of IHD. In either case, the contract physician noted these changes and "felt this was more consistent with Heart 'strain' due to a combination of being out of shape and having pretty high BP [blood pressure] during exercise."

Approximately two weeks prior to his death, the FF-E noted some left sided rib pain while skiing. In addition, as noted earlier, he was taking some medication for indigestion. We will never know if these symptoms were his "angina equivalents" or were correctly attributed to musculoskeletal strain and heartburn respectively. In either case, in the days or hours before his death he never reported any symptoms to his family or co-workers.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this FD consisted of 186 uniformed personnel serving a population of 146,000 in an area of 1400 square miles. There are 15 fire stations with many providing ALS medical service; however patient transport is provided by a private ambulance company. Fire fighters work the following schedule: 24-hours on-duty, 24-hours off-duty, for four days, followed by four days off. Then, 24-hours on-duty, 24-hours off-duty for four days followed by six days off. Shift change occurs at 0800 hours. In 2003, the FD

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responded to 9,423 calls of which 53% were for emergency medical service purposes.

Training. The FD requires all new FF applicants to be a certified FF I and an EMT-D. After taking a written examination, passing the Candidate Physical Ability Test³, and appearing before an oral interview panel, candidates are ranked and placed on a hiring list. When the FD is in a hiring mode, positions are offered contingent on passing a pre-placement medical evaluation, an illicit drug test, and a background check. The newly hired FF candidate is then sent to the County Fire Academy for six to twelve weeks depending on the FF's previous experience. The FF is then assigned a shift for a two year probationary period.

Recurrent training occurs daily on each shift. State FF certification is mandatory. There is mandatory annual refresher training. EMTs and Paramedics recertify every two years. The FF-E was certified as a Fire Fighter II, an engineer, and an EMT-D. He had over 20 years of fire fighting experience.

Pre-placement Evaluations. The FD requires a pre-placement medical evaluation for all applicants, regardless of age. Components of the evaluation include:

- A complete medical history
- Physical examination
- Vital signs
- Vision screening (acuity and color)
- Audiogram
- Blood analysis: chemistries, lipid panel, liver function tests,
- complete blood count (CBC)
- Drug screen (marijuana, opiates, cocaine, methamphetamine, and PCP)
- Urinalysis (dipstick and microscopy)
- Chest x-ray (two views - posterior-anterior & lateral)

- 12-lead resting EKG for candidates less than 40 years old with less than two coronary artery disease (CAD) risk factors
- Bruce protocol exercise stress test (EST) for candidates 40 years old and older, or candidates under 40 years old with two or more CAD risk factors
- Pulmonary function test
- Hepatitis B vaccine
- Skin test for tuberculosis (PPD)

These evaluations are performed by a medical clinic hired by the County, who then makes a decision regarding medical clearance for fire fighting duties. This decision is forwarded to the Department of Human Resources.

Periodic Evaluations. Biennial medical evaluations are required for all members. Components of this medical evaluation include:

- A complete medical history
- Physical examination
- Vital signs
- Body fat analysis
- Flexibility evaluation
- Spirometry
- Respiratory use evaluation
- Blood analysis: chemistry panel, CBC, lipid panel
- Hepatitis C titers, HIV screen, PSA, and thyroid blood tests are available, if requested
- Urinalysis (dipstick)
- Sub-maximal EST (90% of the member's maximum heart rate). This test includes a fitness measure – the calculated MVO_2 .

After reviewing the above information, the FD contract physician assigns a health and fitness category for each fire fighter as follows:

Category 1 - "fit/healthy"

Category 2 - "lifestyle modifications recommended"

Category 3 - "significant medical findings and follow-



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up with the FF's private physician must occur within 90 days and be cleared for full duty Category 4 - "Unfit for duty" and not allowed to return to duty until medically cleared by the FD or the FF's private physician.

If an employee is injured or ill resulting in an absence from work, either the FD contract physician or the FF's private physician can clear them for "return to work."

Fitness/Wellness Programs: Exercise (strength and aerobic) equipment is located in all fire stations. Physical fitness training (PT) time has been written into the FD's policy statements. All safety personnel are required to participate in a PT program for a minimum of one hour and a maximum of 1 1/2 hours per shift for those on shift work, and three times a week for those on a Monday-Friday schedule. The minimum workout involves five minutes of warm-up stretching/exercises, 30 minutes of aerobic activity followed by a five minute cool-down period and 20 minutes for a shower. While this policy is followed by the vast majority of companies, a few officers were reported to not require participation. Finally, as mentioned earlier, the biennial medical evaluation includes a cycle ergometer fitness test, a body fat analysis, and flexibility evaluation.

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 its development include age over 45, male gender, family history of coronary artery disease, smoking, high blood pressure (systolic >140 millimeters of mercury [mmHg] or diastolic > 90 mmHg), high blood cholesterol (total cholesterol >

240 milligrams per deciliter [mg/dL]), obesity/physical inactivity, and diabetes.^{5,6} The deceased had three of these risk factors (male gender, hypertension, and high blood cholesterol).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.⁷ However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.⁸ 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.⁹ This sudden blockage is primarily due to blood clots (thrombosis) forming on the top of atherosclerotic plaques. The deceased did not have a blood clot on autopsy but he did have evidence of atherosclerotic disease in his coronary arteries with 90% narrowing of his left anterior descending and left circumflex coronary artery.

Atherosclerosis in a coronary artery may cause ischemic heart disease which occurs when the blood flow within a coronary artery is limited to the point where the oxygen needs of the heart muscle cannot be met. Chronic ischemic heart disease causes hypertrophy of the heart muscle and cardiomegaly. All of these factors, independently and in combination (ischemia, cardiomegaly, or myocardial infarction), increase the risk of cardiac arrhythmia and sudden cardiac death.

It is probable that the FF-E suffered a heart attack. The term "probable" is used because autopsy findings (thrombus formation), blood tests (cardiac isoenzymes), or ECG findings are required to "confirm" a heart attack [myocardial infarction (MI)]. The victim did not have a coronary artery thrombus on autopsy; he died prior to the cardiac isoenzymes becoming positive, and he had no heart beat to show the characteristic findings of a heart attack on his ECG.

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Angina is the most common presenting symptom of myocardial ischemia and underlying CAD, but in many persons the first evidence of CAD may be myocardial infarction or sudden death.¹⁰ Some individuals may not experience angina with ischemia, as evidenced by up to 20% of heart attacks being “silent,” i.e., painless.⁷ On the other hand, sometimes atypical symptoms (indigestion, left arm pain, jaw pain, etc.) can be an expression of angina. The FF-E’s indigestion or left sided chest pain while skiing may have been an atypical presentation of his angina. On the other hand, these symptoms did not seem to have any relationship to physical exertion, and could very well have represented heartburn and a muscle strain, respectively.

Firefighting is widely acknowledged to be one of the most physically demanding and hazardous of all civilian occupations.¹¹ Firefighting activities are strenuous and often require fire fighters to work at or near maximal heart rates for long periods. The increase in heart rate has been shown to begin with responding to the initial alarm and persist through the course of fire suppression activities.¹²⁻¹⁴ Even when energy costs are moderate (as measured by oxygen consumption) and work is performed in a thermoneutral environment, heart rates may be high (over 170 beats per minute) owing to the insulative properties of the personal protective clothing.¹⁵ Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.¹⁶⁻¹⁹ The deceased pulled a 35-40 pound lawn mower up a 20% grade for approximately ¼ mile. This is considered a very heavy level of physical exertion.²⁰⁻²¹ The physical stress of exercising and his underlying atherosclerotic CAD contributed to this FF-E’s cardiac arrest and sudden death.

Use of Exercise Stress Tests (EST) to Screen for CAD: Could this FF-E’s underlying CAD have been identified earlier? As mentioned earlier, the FF-

E had some new EKG changes suggestive of ischemic heart disease due to CAD during his cycle ergometer exercise stress test (EST). In retrospect, two additional non-invasive diagnostic options could have been considered: 1) repeating the EST with an imaging (e.g. thallium) component, or 2) conducting a symptoms limiting (maximal) EST. Both the 2000 and the 2003 edition of NFPA Standard 1582, allows “sub-maximal” EST.^{22,23} On the other hand, the American Heart Association and the American College of Cardiology (AHA/ACC) “strongly prefer” other end points (maximal EST).²⁴ Either one of these tests may have identified his underlying disease, each leading to the possibility of further evaluation and treatment of his CAD.

Conducting EST on asymptomatic individuals is controversial. As mentioned above, NFPA Standard 1582 recommends, not as a part of the requirements but for informational purposes only, that all fire fighters with two or more risk factors for CAD be given an EST. The Standard goes on to list the criteria for CAD risk factors: hypercholesterolemia (total cholesterol greater than 240 mg/dL), hypertension (diastolic blood pressure greater than 90 mm Hg), smoking, diabetes mellitus, or family history of premature CAD (heart attack or sudden cardiac death in a first-degree relative less than 60 years old).²²

The AHA/ACC states that the evidence to conduct EST in asymptomatic individuals with diabetes mellitus is “Class IIa: there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy but the weight of the evidence/opinion is in favor.”²⁴ The AHA/ACC goes on to say the evidence is “less well established” (Class IIb) for the following groups:

1. Evaluation of persons with multiple risk factors as a guide to risk-reduction therapy with the risk factors essentially the same as the NFPA listed above.

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2. Evaluation of asymptomatic men older than 45 years, and women older than 55 years:

- Who are sedentary and plan to start vigorous exercise
- Who are involved in occupations in which impairment might jeopardize public safety [e.g. fire fighters]
- Who are at high risk for CAD due to other diseases (e.g. peripheral vascular disease and chronic renal failure).

Another organization weighing in on the subject is the U. S. Department of Transportation (DOT). To obtain medical certification for a commercial drivers license, they recommend EST for drivers over the age of 45 with more than two CAD risk factors.²⁵ Finally, the U.S. Preventive Services Task Force (USPSTF) does not recommend EST for asymptomatic individuals, even those with risk factors for CAD; rather, they recommend the diagnosis and treatment of modifiable risk factors (hypertension, high cholesterol, smoking, and diabetes).²⁶ The USPSTF indicates that there is insufficient evidence to recommend screening middle age and older men or women in the general population but notes that “screening individuals in certain occupations (pilots, truck drivers, etc.) can be recommended on other grounds, including the possible benefits to public safety.”

Other Issues: The pathologist conducting the autopsy diagnosed biventricular dilatation. My review of the autopsy report, however, suggests the deceased had right ventricular dilatation (luminal diameter of 4 cm) (normal is 0.7-2.3 cm), but not left ventricular dilatation (luminal diameter of 4 cm with normal being between 3.7-5.6 cm).²⁷ In either case, the deceased had a confirmed dilated right ventricle probably representing a condition called dilated cardiomyopathy (DC). Most cases of DC are of unknown etiology (idiopathic DC or IDC), although a variety of acquired or hereditary disorders can

cause the disorder. These secondary and potentially reversible forms are listed in Table 1.²⁸

IDC has been associated with an increased risk of arrhythmias and sudden cardiac death.²⁸ Although a variety of symptoms and medical tests can provide prognostic information, patients at greatest risk of sudden death or in need of anti-arrhythmic therapy are hard to identify.²⁸ Given the inability to identify patients at high risk for sudden death, the low degree of efficacy of anti-arrhythmic agents for DC, the numerous side effects of these anti-arrhythmic agents, and the lack of symptoms in the deceased, it is unclear if an earlier diagnosis of DC could have prevented his sudden death. Finally, since many cases of DC are inherited, first-degree relatives of this FF-E may want to consult with their physicians regarding an echocardiogram to screen for DC.

RECOMMENDATIONS AND DISCUSSION

The first recommendation below addresses a safety issue specific to this event. The next two recommendations are preventive measures recommended by other fire service groups to reduce the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. The final recommendation addresses a potential safety issue unrelated to this particular event.

Recommendation #1: Consider some other method of cutting the grass on the steep hill behind Station 18.

Pulling a cutting lawn mower up a steep hill presents two problems. First, if the puller slipped, their foot could slide under the cutting blade representing a safety hazard. Second, the aerobic requirements are probably greater than walking or jogging up the hill, thereby putting an additional stress on the individual. We suggest the FD consider another type of cutting



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method, perhaps a weed whacker/weed eater which is lighter and probably safer to use.

Recommendation #2: Provide annual medical evaluations to fire fighters to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

We applaud the efforts of the occupational health clinic for implementing a comprehensive medical evaluation and examination program, in addition to a fitness evaluation program. This program, however, has some discrepancies with the 2003 edition of NFPA 1582, a copy of which is enclosed. Specific recommendations include:

- Conducting medical evaluations on an annual, rather than biennial, basis
- Including hearing and vision screening tests on an annual basis
- Discontinuing the routine use of resting EKGs
- Discontinuing EST in fire fighters under the age of 45 years old
- Conducting maximal EST (not sub-maximal) in fire fighters above the age of 45 years with two or more risk factors for CAD (see AHA guidelines listed above)

Applying NFPA 1582 involves legal and economic repercussions and must be carried out in a nondiscriminatory manner. Appendix B of NFPA 1582 provides guidance for FD Administrators regarding legal considerations in applying the standard.²²

Economic repercussions go beyond the costs of administering the medical program. Department administrators, unions, and fire fighters must also deal with the personal and economic costs of the medical testing results. NFPA 1500 addresses these issues in Chapter 8-7.1 and 8-7.2.²⁹ The success of medical

programs may hinge on protecting the affected fire fighter. For FF in rehabilitation programs, the FD should provide alternate duty positions. If the fire fighter is not medically qualified to return to duty after repeat testing, supportive and/or compensated alternatives for the fire fighter should be pursued by the Department.

Recommendation #3: The FD and the local Union should negotiate to phase-in a mandatory fitness and wellness program consistent with NFPA 1583 and/or the Fire Service Joint Labor Management Wellness/Fitness Initiative.

The FD currently provides one hour of protected time for physical fitness training each shift, however, individual compliance appears to be dependent on each crew's supervisor/Captain. Physical inactivity is the most prevalent modifiable risk factor for CAD in the United States and is independently associated with obesity and diabetes.³⁰ A comprehensive fitness program, such as NFPA 1583 *Standard on Health-Related Fitness Programs for Fire Fighters*, also provides health promotion activities for preventing health problems and enhancing overall well-being.³¹ Another example of a comprehensive fitness/wellness program is the Fire Service Joint Labor Management Wellness/Fitness Initiative published by the International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) in 1997.³² Copies of both these documents are enclosed. We recommend the FD and the union review these documents to identify elements that could be added to strengthen the existing program.

Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.³³⁻³⁴ Cost savings have been reported by the wellness program at the Phoenix Fire Department, where a 12-year



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commitment has resulted in a significant reduction in disability pension costs.³⁵

Recommendation #4: Following an injury/illness, the final determination of a fire fighter's return-to-work status should be made by the fire department physician who is knowledgeable about the physical demands of fire fighting, the medical requirements of fire fighters, and the various components of NFPA 1582.

Physicians providing input regarding medical clearance for fire-fighting duties should be knowledgeable about the physical demands of fire fighting and that fire fighters frequently respond to incidents in environments that are immediately dangerous to life and health (IDLH).¹¹⁻¹⁵ They should also be familiar with the consensus guidelines published by *NFPA 1582, Standard on Comprehensive Occupational Medicine Program for Fire Departments*.²² To ensure physicians are aware of these guidelines, we recommend that the FD provide the contract physician with a copy of NFPA 1582. We recommend the FD physician consider, but not necessarily “rubber stamp” the opinions of the treating physician regarding return-to-work. This decision requires knowledge not only of the medical condition, but also of the fire fighter’s job duties. Personal physicians may not be familiar with an employee’s job duties, or guidance documents, such as NFPA 1582. In addition, they may consider themselves as patient advocates and dismiss the potential public health impact of public safety officials who may be suddenly incapacitated. Therefore, we recommend that all return-to-work clearances be reviewed by the FD contract physician who has the final decision regarding medical clearance.

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INVESTIGATOR INFORMATION

This investigation was conducted by and the report written by Thomas Hales, MD, MPH. Dr. Hales is a senior medical epidemiologist with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio. He is board certified in internal and occupational medicine.



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Table 1. Known Causes of Dilated Cardiomyopathy²⁴

Toxins

Ethanol
Chemotherapeutic agents (doxorubicin, bleomycin)
Cobalt
Anti-retroviral agents (zidovudine, didanosine, zalcitabine)
Phenothiazines
Carbon monoxide
Lead
Cocaine
Mercury

Metabolic Abnormalities

Nutritional deficiencies (thiamine, selenium, carnitine)
Endocrinologic disorders (hypothyroidism, acromegaly, thyrotoxicosis, Cushing’s Disease, pheochromocytoma, diabetes mellitus)
Electrolyte disturbances (hypocalcemia, hypophosphatemia)

Infectious

Viral (coxsackie virus, cytomegalovirus, human immunodeficiency virus)
Rickettsial
Bacterial (diphtheria)
Mycobacterial
Fungal
Parasitic (toxoplasmosis, trichinosis, Chagas’ disease)

Noninfectious

Collagen vascular disorders (scleroderma, lupus erythematosus, dermatomyositis)
Hypersensitivity myocarditis
Sarcoidosis
Peripartum dysfunction

Neuromuscular Causes

Duchenne’s muscular dystrophy
Facioscapulohumeral muscular dystrophy
Erb’s limb-girdle dystrophy
Myotonic dystrophy