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NIOSH

Fire Fighter Fatality Investigation and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation *September 6, 2005*

Fire Fighter Suffers a Heart Attack After Responding To a Rubbish Fire at a Two-Story Appartment Building – New York

SUMMARY

On September 27, 2003, a 40-year-old male Fire Fighter (FF), assigned as the Chauffeur (Driver/Operator) of a ladder truck, responded to a rubbish fire at a two-story apartment building. On the fire scene, the FF wore his turnout gear but no self-contained breathing apparatus (SCBA). He remained with the ladder truck and passed search and overhaul equipment to his crew. Nine minutes after arrival, his ladder company was released and returned to quarters. Observing the FF's pale appearance, crew members were concerned about his health. He stated that he would be fine and was going home soon. At the end of his shift, he drove the 45 miles to his home. On the way home, he called his wife and explained that he was ill. As he pulled into his driveway, his wife went outside and checked on him, noting his shortness of breath and chest pain, and called 911. An ambulance responded and transported him to the local hospital, providing advanced life support (ALS) for 15 minutes. In the hospital's emergency department (ED), his condition deteriorated. Cardiopulmonary resuscitation (CPR) (chest compressions and assisted ventilations via bag-valve-mask, intubation, and oxygen) and ALS was administered for 77 minutes. Despite ALS administered by ambulance paramedics and ALS and CPR by hospital personnel, the FF died. The death certificate, completed by the attending physician listed "acute myocardial infarction" as the immediate cause of death and "diabetes mellitus" and "hypertension" as other significant conditions. No autopsy was performed. His moderate physical exertion during the response coupled with his underlying coronary artery disease (CAD), probably triggered his heart attack and sudden cardiac death.

NIOSH investigators offer the following recommendations to prevent similar incidents:

Ensure members' primary care physicians are knowledgeable of NFPA 1582 guidelines regarding medical conditions compromising a member's ability to safely perform essential job tasks.

Ensure members are knowledgeable of, and comply with, fire department requirements regarding reporting any medical condition that could interfere with their ability to safely perform essential job tasks.

Consider symptom-limiting (i.e., maximal) exercise stress tests for asymptomatic fire fighters with multiple CAD risk factors.

Negotiate with the Union to phase in a <u>MANDATORY</u> wellness/fitness program for fire fighters.

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 Suffers a Heart Attack After Responding To a Rubbish Fire at a Two-Story Apartment Building – New York

INTRODUCTION & METHODS

On September 27, 2003, a 40-year-old male Fire Fighter felt ill after responding to an outside rubbish fire at a two-story apartment building. Despite prompting by his officer to seek medical attention, the FF elected to drive home after his shift ended. He experienced severe shortness of breath and chest pain while en route but arrived safely at his home. After discovering him in his car and slumped over, his wife called 911, who dispatched an ambulance. Despite ALS by ambulance paramedics and CPR and ALS by the hospital ED, the FF died. NIOSH was notified of this fatality on October 1, 2003, by the United States Fire Administration. On October 2, 2003, NIOSH contacted the affected FD to initiate the investigation. On November 17, 2003, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to New York to conduct an onsite investigation of the incident.

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

- FD Executive Officer, Safety Command
- FD Deputy Chief Medical Officer
- Deputy Medical Director
- Local Union Safety Representative
- FF's wife

During the site-visit NIOSH personnel reviewed the following records:

- FD investigative report of the fatality
- FD policies and operating guidelines
- FD training records of the deceased
- FD medical records of the deceased
- FD annual report for 2002
- Emergency medical service (ambulance) report
- Hospital records relating to this incident
- Death certificate
- Primary care physician (PCP) records

INVESTIGATIVE RESULTS

Incident. On September 26, 2003, the FF arrived for duty at Ladder 127 at 1800 hours. He was scheduled to work the night tour from 1800 hours until 0900 hours the next day (September 27). The FF had made previous arrangements to exchange tours with another fire fighter to also work the next shift (0900 hours to 1800 hours). During both these tours he was assigned the Chauffeur (Driver/Operator) position. Ladder 127 responded to the following six alarms during the two tours: one occupied structural fire, three emergencies, one car fire, and the outside rubbish fire described below.

At 1651 hours, dispatch received a telephone call reporting a rubbish fire between buildings that had spread to an adjacent garden apartment building. The building was a two-story Class 3, non-fireproof, L-shaped multiple dwelling measuring approximately 80-feet by 100-feet. At 1653 hours, Engine 305 was dispatched. At 1654 hours, a second source call was received regarding the fire and a full first alarm assignment was dispatched including Engine 303, Ladder 151, Ladder 127 (including the FF), and Battalion 51. A total of 23 fire fighters, including a Battalion Chief responded. For the response timeline, see Table 1.

At 1658 hours, units began to arrive on the scene and responders found a pile of cardboard boxes on fire between two buildings. Ladder 127 was

TABLE 1

1651 hours: Dispatch received a telephone call reporting a rubbish fire between buildings.

1653 hours: Engine 305 was dispatched.

1654 hours: Received a second source (second call reporting the fire); filling out the alarm.
Engine 299, Engine 303, Ladder 151, Ladder 127 (including the FF), and Battalion 51 were dispatched.

1657 hours: Engine 315 and Ladder 125 were dispatched.

1658 hours: Engine 298 and Battalion 50 were dispatched.
Battalion 51 available on the air.
Engine 305 arrived on the scene.
Engine 303 available on the air.

1659 hours: Ladder 151 arrived on the scene.

1700 hours: Ladder 125 arrived on the scene.
E315 arrived on the scene.
E299 arrived on the scene.
E298 arrived on the scene.

1702 hours: Battalion 50 arrived on the scene.

1704 hours: Ladder 127 arrived on the scene.

1705 hours: "Address", two-story, occupied, brick, 80 x 100, fire located in the breezeway, two street exposures.

1708 hours: 41 R 10-EP

1709 hours: Condition Code 01

1711 hours: Engine 298 available on the air.

1713 hours: Ladder 127 available on the air.

1713 hours: Engine 299 available on the air.

1715 hours: Engine 315 acknowledged.

1725 hours: Ladder 151 available on the air.

1728 hours: Battalion 50 available on the air.

1730 hours: Engine 315 available in quarters.
Ladder 125 available in quarters.

1734 hours: Engine 305 available in quarters.
Close incident.

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assigned to perform search and overhaul. The FF, as the Chauffeur, remained with the Truck, obtaining equipment as needed for his crew. After approximately 9 minutes on scene, the fire was declared under control and units returned to quarters at 1713 hours.

Back in the station at approximately 1720 hours, crew members noticed the FF looked pale. He went to the third floor locker room, sat down, and leaned over a table. On two separate instances, the Truck Officer checked on the FF; each time the FF replied that he was going home soon and would be all right.

The FF's shift ended at 1800 hours and he drove 45 miles to his home. During the drive home, he called his wife and mentioned he had some chest pain and shortness of breath. Upon arriving at his home at approximately 1952 hours, his wife found him in his car, slumped over and very short of breath with chest pains; he was pale in color and with clammy skin. She called 911 and requested an ambulance.

The ambulance was dispatched at 1954 hours, responded at 1958 hours, and arrived at the FF's home at 2000 hours. Paramedics staffing the ambulance found the FF in mild distress complaining of shortness of breath and his "heart racing." Vital signs revealed a pulse of 290 beats per minute (normal 60-100), respiratory rate of 24 breaths per minute; paramedics were unable to ascertain his blood pressure (BP). A cardiac monitor revealed ventricular tachycardia (Vtach), a life threatening heart arrhythmia. Intravenous (IV) medications and fluids consistent with ALS protocols were administered followed by 100% oxygen given by a non-rebreather mask. The FF was placed onto a stretcher, loaded into the ambulance, and transported to the hospital at 2009 hours. Neither his heart rate nor his level of consciousness changed en route to the hospital. At 2016 hours, the ambulance arrived at the hospital.

Initial evaluation in the ED found the FF in severe distress, complaining of shortness of breath, chest pain, and weakness. He had a diminished peripheral pulse at 250-270 beats per minute and a BP of 95/75 millimeters of Mercury (mmHg). An electrocardiogram (EKG) revealed the following findings: 1) atrial flutter (a heart arrhythmia) with 1 to 1 ventricular conduction, 2) right bundle branch block (a heart conduction problem), and 3) inferior infarct (a heart attack), age undetermined. At 2043 hours, the FF stopped breathing, lost his pulse, and became unconscious; CPR was begun. Over the next 77 minutes ALS resuscitation measures were implemented including intubation, 25 defibrillation attempts, and resuscitation medications with no change in his clinical condition. At 2200 hours, the FF was pronounced dead and resuscitation measures were discontinued.

Medical Findings. The death certificate, completed by the attending physician, listed "acute myocardial infarction" as the immediate cause of death and "diabetes mellitus" and "hypertension" as other significant conditions. No autopsy was performed.

Medical records from the FD and the FF's primary care physician (PCP) from 1985 to 2003 revealed the following:

1. Diabetes mellitus (DM). Although the FF had an elevated blood glucose noted in 1994 (124 milligrams per deciliter [mg/dL] with normal being 65-115 mg/dL), he was not diagnosed with DM until 1998. Once diagnosed, he was treated by his PCP with a weight loss program

and an oral hypoglycemic agent. He was not successful in losing weight, but was generally compliant with his medication. Over the past 5 years his blood glucose level ranged from 99 mg/dL to 305 mg/dL with hemoglobin A_{1C} (HbA_{1C}) levels ranging from 5.4% to 9.1%. HbA_{1C} measures blood glucose control over the past 6-8 weeks. A HbA_{1C} level of < 7% represents fair blood glucose control.

Although the FD was aware of his elevated blood glucose levels, they were unaware of his DM diagnosis until his January 2003 FD annual medical evaluation. At that time he had a blood glucose level of 231 mg/dL and HbA_{1C} of 8.0. He was placed on medical leave for 8 days and light duty for 181 days. He denied having a previous diagnosis of DM to the FD medical clinic. He was allowed to return to full duty on July 17 after reporting he was not taking any hypoglycemic agents and having a glucose level of 119 mg/dL and a HbA_{1C} of 5.7. According to his PCP medical records, however, he was still being prescribed oral hypoglycemic medications.

2. Hypertension (HTN). He was diagnosed in 1997 and prescribed an anti-hypertensive medication. Over the past 6 years he had moderate control of his blood pressure and, at the time of his death, he was taking two anti-hypertensive medications. Although the FD medical clinic had several elevated blood pressure measurements, the clinic never diagnosed him with HTN, and the clinic was never told by the FF or the FF's PCP about his HTN diagnosis or his treatment with anti-hypertensive medications.

3. Positive family history. According to PCP records, the FF's father had coronary artery disease (CAD) and DM; his mother had CAD.

4. Obesity. At his candidate physical evaluation in 1985, the FF weighed 210 pounds and was 75 inches tall, giving him a body mass index (BMI) of 26.2 (a BMI over 25.0 is considered overweight).[1] Two months prior to his death he weighed 340 pounds, giving him a BMI of 42.5 (extreme obesity).[1] Recommendations to lose weight began in 1997 and continued until his death.

5. Hypercholesterolemia. The first elevated total cholesterol reading was in 1997 (209 mg/dL) (with normal 143-200 mg/dL). At this time, however, the FF's low density lipoprotein (LDL) levels and his total cholesterol/high density lipoprotein (Chol/HDL) ratios were normal, which are more important prognostic indicators than total cholesterol.[2] Nonetheless, the FD medical clinic, as well as the FF's PCP recommended dietary modification.

6. Heart conduction abnormalities. As part of the Chauffeur medical evaluation, the FD conducted an EKG on the FF in 1993. The EKG showed an incomplete right bundle branch block (RBBB) which was reported to be unchanged from prior EKGs. An EKG conducted as part of the FD's annual medical evaluation in 1998 showed sinus tachycardia, left axis deviation, possible left anterior fascicular block, and a possible old anterior heart attack (infarction). Because he was asymptomatic, the FD medical clinic recommended he seek further evaluation from his PCP. It is unclear if the FF followed this recommendation and the FD medical clinic did not follow-up.

In April 2003, the FF was hospitalized for an episode of atrial fibrillation with slow ventricular response. This was successfully converted

to a normal sinus rhythm using oral medication (digoxin and a beta blocker). During his hospitalization, an echocardiogram was performed to ascertain the cause for the atrial fibrillation. The FF followed up with an outpatient cardiology consultation as recommended by his PCP. An echocardiogram, performed in May 2003, revealed a dilated left atrium, an enlarged left ventricle with mild to moderate concentric hypertrophy with a normal left ventricular ejection fraction, a dilated right ventricle with questionable mild hypokinesis, and 1-2+ tricuspid insufficiency (a heart valve problem). A Holter Monitor, worn for 24 hours, revealed atrial fibrillation, no ventricular tachycardia or supraventricular tachycardia, and two isolated pauses (slow ventricular response of 2.6 seconds). In June 2003, an EKG revealed atrial fibrillation with rapid ventricular rate. The FD medical clinic was never informed of his April hospitalization, nor of any of the subsequent test results.

7. Restrictive pulmonary disease. During the FF's April 2003 hospitalization, he was noted to have abnormal spirometry measurements (forced expiratory volume [FEV_1] 60% and forced vital capacity [FVC] 59%) suggesting moderate restrictive lung disease. It is unclear if these spirometry abnormalities were noted during his previous FD annual medical evaluations in 1998, 2001, or 2003. With his normal chest x-ray, these restrictive abnormalities were probably related to his obesity.

8. Asthmatic bronchitis. Two months prior to his death, the FF had an episode of asthmatic bronchitis treated by his PCP as an outpatient. He was given steroids and bronchodilators for 7 days. It is unlikely the FF or his PCP relayed this information to the FD physician because no mention of this episode was included in FD medical records.

According to his wife and crew members, the FF had no complaints of chest pains or any symptoms suggestive of acute heart-related problems immediately prior to this incident and he maintained a moderate amount of physical activity.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the FF's death, the FD consisted of approximately 11,495 Uniformed Fire Fighters and Fire Officers, 2,677 EMTs and Paramedics, 222 Fire Marshals, 195 Fire Inspectors, and 1,741 administrative support personnel serving a population of eight million residents in a geographic area of 322 square miles. There are over 300 fire stations and buildings. The emergency medical services have operated as a function of the FD since 1996. Fire fighters work the following shifts: Day 1 & 2: 9am to 6pm; Day 3: off; Day 4 & 5: 6pm to 9am; Day 6-8: off.

In 2002, the FD responded to 426,542 calls, including 26,248 structural fires, 25,315 non-structural fires, 170,867 non-fire emergencies, 158,461 medical emergencies, and 45,651 malicious false alarms. Included in the responses were 2,946 serious incidents involving 2,686 all hands, 217 second alarms, 26 third alarms, 15 fourth alarms, and 2 fifth alarms or greater incidents. Typical engine company staffing is four fire fighters plus one officer (some engine companies have five fire fighters plus one officer); typical ladder company staffing is five fire fighters plus one officer. This staffing level meets NFPA 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Depart-*

ments (2004). Automated external defibrillators (AEDs) are carried on all fire engines. Prior to the incident, the FF was on duty for 23 hours (he had switched a shift with another member of the company) and had responded to six alarms including one occupied structural fire, three emergencies, one car fire, and the outside rubbish fire.

Training. The FD requires all fire fighter candidates to complete an application and background checks and pass a City candidate physical ability test prior to being offered conditional employment. Candidates must then pass a pre-placement physical examination prior to being fully hired. Newly hired fire fighters then attend a 12-week training program at the Division of Training, after which they are certified fire fighters. This training includes certification as a first responder, which includes CPR and AED. Chauffeurs (Driver/Operators) are required to undergo an additional two-week training course. The State requires 100 hours training for annual recertification for career fire fighters. The FF was certified as a Fire Fighter I, Hazardous Materials Operations level, and Driver/Operator, and had 17 years of fire fighting experience.

Pre-placement Medical Evaluations. The FD requires a pre-placement medical evaluation for all fire fighter candidates. The pre-placement evaluation includes the following items:

- A complete medical history and questionnaire
- Height, weight, and vital signs
- Physical examination
- Vision test
- Hearing test
- Blood tests: Complete blood count (CBC), chemistry panel (SMA 20) which includes cholesterol and triglyceride measurement
- Urinalysis
- Urine drug test
- Spirometry (lung function tests)
- Resting EKG
- Chest X-ray
- Skin test for tuberculosis (PPD)
- Immunizations administered if proof of vaccination cannot be provided (hepatitis B, measles, mumps, & rubella (MMR), tetanus if a booster had not been given within the past ten years)
- Fire fighters assigned to waterways also are offered a hepatitis A vaccine.

These evaluations are performed by the FD Medical staff, who make a decision regarding medical clearance for fire fighting duties. New hires are also required to complete a physical fitness and strength test at the time of the medical evaluation. The aerobic test involves 3 minutes on a Stairmaster at 60 steps per minute with a 60-pound pack. An EKG is not taken, but the heart rate is recorded and must be less than 90% of maximum (220 minus age).

Periodic Medical Evaluations. Since 1998, periodic medical evaluations have been required by this FD for **all** fire fighters. The goal has been to conduct these on an annual basis, but logistical problems have resulted in their being conducted approximately every 15 months. Components of this evaluation are identical to the pre-placement evaluation with the following three exceptions: the chest X-ray is required only every 3 years, 2) the drug screen is not required, 3) and the aerobic fitness test does not include a 60-pound pack and the passing heart rate is 85% of the fire fighter's maximum. This FF's last periodic medical evaluation, conducted by the FD in January 2003,

revealed DM, hypercholesterolemia (with normal LDL and cholesterol/HDL ratios), and obesity. Due to his DM, he was first placed on medical leave for 7 days, then placed on light duty for 6 months. During that time, he was prescribed oral medication to control his glucose level, and was dieting and exercising. Subsequent FD medical testing in July 2003 revealed normal glucose and HbA_{1C} levels and the FF was cleared for unrestricted fire fighting duties. Although his PCP had prescribed oral hypoglycemic medications at that time, it is unclear if the FF was taking them. FD medical records did not indicate knowledge of his recent EKG abnormalities, abnormal pulmonary function tests, outpatient episode of asthmatic bronchitis, or his recent (April 2003) hospitalization.

Medical Clearance and Fitness/Wellness Programs. A fire fighter injured at work must be evaluated and cleared for "return to work" by a physician in the FD's medical clinic. A fire fighter who misses work for one or more days because of an illness (work-related or not), must also be evaluated and cleared for "return to work" by the FD Medical staff.

All fire houses have exercise (strength and aerobic) equipment, typically purchased by the fire fighters themselves. There are voluntary smoking cessation and weight control programs, and a voluntary non-punitive wellness/fitness program designed by the FD medical clinic in collaboration with nine other fire departments, the IAFF, and the IAFC.[3]

DISCUSSION

Coronary Artery Disease (CAD) and the Pathophysiology of Sudden Cardiac Death. In the United States, CAD (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 mmHg or diastolic > 90 mmHg), high blood cholesterol (total cholesterol > 240 mg/dL), obesity/physical inactivity, and diabetes.[5,6] The FF had five CAD risk factors including male gender, family history, hypertension, obesity, and diabetes.

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 has not developed a collateral blood supply.[9] This sudden blockage is primarily due to blood clots (thrombosis) forming on top of atherosclerotic plaques.

Blood clots, or thrombus formation, in coronary arteries is initiated by disruption of atherosclerotic plaques. Certain characteristics of the plaques (size, composition of the cap and core, presence of a local inflammatory process) predispose the plaque to disruption.[6] Disruption then occurs from biomechanical and hemodynamic forces, such as increased blood pressure, increased heart rate, increased catecholamines, and shear forces, which occur during heavy exercise.[8,9]

It is possible that the FF suffered a heart attack. The term "possible" is used because autopsy findings (thrombus formation), blood tests (cardiac isoenzymes), or EKG findings are required to "confirm" a heart attack (myocardial infarction [MI]). The FF did not have an autopsy to identify a coronary artery thrombus; he died prior to the cardiac isoenzymes becoming positive, and he had an EKG suggesting a heart attack to the inferior portion of his heart, but it is unclear if this was a recent event, or one occurring years ago.

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Firefighting is widely acknowledged to be one of the most physically demanding and hazardous of all civilian occupations.[10] 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.[11-13] The FF had responded to six alarms during his two shifts where he performed moderate physical exertion. This physical exertion, coupled with his probable underlying CAD, triggered his possible heart attack and/or heart arrhythmia leading to his subsequent cardiac death.

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) has developed the NFPA 1582 guideline, *Standard on Comprehensive Occupational Medicine Program for Fire Departments*.[14] This FF died when the 2000 edition of NFPA 1582 was in effect. According to the 2000 Edition, the FF had numerous Category B conditions: [15]

- diabetes mellitus
- hypertension
- atrial fibrillation
- significant heart valve lesion
- an episode of bronchial asthma
- restrictive lung disease
- medications (cardiovascular and steroids)

Category B conditions could, but do not require, precluding a member from fire fighting duties.[15] The FD medical clinic was never informed of these conditions by the FF, his PCP, or his medical specialists. With the exception of elevated blood pressure readings and possible abnormal spirometry measurements, the FD's annual medical evaluations could not have identified the FF's underlying medical conditions.

Use of Exercise Stress Tests to Screen for CAD. In addition to screening for CAD risk factors, NFPA 1582 recommends an EST for some asymptomatic (i.e., no symptoms of angina) fire fighters. Conducting EST on asymptomatic individuals is somewhat controversial.[16-18] The 2000 Edition of NFPA 1582, Annex A (not as a part of the requirements but for informational purposes only) recommends that an EST be conducted on fire fighters 35 years or older with one or more risk factors for CAD, or age 40 for fire fighters with no CAD risk factors. The Standard lists the following criteria for CAD risk factors: hypercholesterolemia (total cholesterol greater than 240 mg/dL), hypertension (systolic blood pressure greater than 140 mmHg or diastolic greater than 90 mmHg), smoking, diabetes, or family history of premature CAD (cardiac event in first degree relative less than 60 years old).[15] Since the FF denied any of these CAD risk factors to the FD's medical clinic (in fact he had three), according to NFPA he had just reached the age when an EST was recommended.

Once the FD became aware of the FF's DM in January 2003, an EST could have been considered.

The American College of Cardiology/American Heart Association (ACC/AHA) recommends EST for diabetics with any of the following characteristics:

1. age older than 35 years
2. type 2 diabetes greater than 10 years' duration
3. type 1 diabetes greater than 15 years' duration

4. any additional CAD risk factors listed in the above paragraph
5. organ damage due to diabetes (proliferative retinopathy, nephropathy, autonomic neuropathy, or peripheral vascular disease).[16,19]

Since the FF was over 35 years old, ACC/AHA guidelines recommend an EST. A maximal EST, conducted according to ACC/AHA specifications, may have identified his probable underlying CAD, and/or his cardiac conduction disturbances (atrial fibrillation or ventricular arrhythmias). Additional evaluation and treatment may have prevented his death at this time.

Although the FD has non-punitive light duty positions and extensive rehabilitation programs, and the State has a presumptive "heart bill" which could have allowed him to retire, this FF did not inform the FD's medical clinic regarding his medical conditions. This decision probably cost him his life. In addition, this represented a safety risk to his coworkers and the general public.

RECOMMENDATIONS and DISCUSSION

NIOSH investigators offer the following recommendations to prevent similar incidents:

Recommendation #1: Ensure members' primary care physicians are knowledgeable of NFPA 1582 guidelines regarding medical conditions compromising a member's ability to safely perform essential job tasks.

The FD physician is responsible for making return to work decisions. The decision should be based, in part, on information from the member, the member's primary care physician, or the member's medical specialists. NIOSH investigators recommend the FD consider a type of return to work clearance form that requires the member's physician to acknowledge their familiarity with NFPA 1582.

Recommendation #2: Ensure members are knowledgeable of, and comply with, fire department requirements regarding reporting any medical condition that could interfere with their ability to safely perform essential job tasks.

At the time of this FF's death, the FD had a policy which required members to notify the medical clinic of any medical condition. The FF was not compliant with this policy for seven medical conditions. NIOSH investigators encourage the FD and the Union to discuss this issue and develop more effective programs and policies. Although NIOSH investigators recommend non-punitive solutions, when effective, disciplinary action, reduction in member death benefits, or other punitive approaches, need to be discussed.

Recommendation #3: Consider symptom-limiting (i.e., maximal) exercise stress tests for asymptomatic fire fighters with multiple CAD risk factors.

The 2003 Edition of NFPA 1582 states, "In those with two or more risk factors for coronary artery disease……there is probable justification for performing stress electrocardiography."[14] This FD is fully aware of the NFPA recommendations regarding EST and the consensus opinion on which they are based. They have made an informed decision, taking into account the advantages and disadvantages of conducting EST in asymptomatic fire fighters regardless of the number of CAD risk factors present. Although the FF never informed the FD medical clinic of his three CAD risk factors, the FD was aware he was a diabetic. The ACC/AHA recommends EST

for diabetics over the age of 35. Although the FF passed the Stairmaster® portion of his annual fitness test in January 2003, had a symptom-limiting EST been performed and his underlying cardiac disease been further evaluated and treated, perhaps his sudden cardiac death could have been prevented at this time.

Recommendation #4: Negotiate with the Union to phase in a MANDATORY wellness/fitness program for fire fighters.

As mentioned earlier, the FD has an extensive voluntary, wellness and fitness program. NIOSH investigators and the NFPA feel these programs should involve mandatory participation during workshifts.[20] Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.[21-23] A cost savings has been reported by the wellness program at the Phoenix Fire Department, where a 12-year commitment has resulted in a significant reduction in disability pension costs.[24]

REFERENCES

1. National Heart Lung Blood Institute [2003]. Obesity education initiative. World Wide Web (Accessed September 2003). Available from http://www.nhlbisupport.com/bmi/bmicalc.htm.

2. AHA [1991]. An updated coronary risk profile; a statement for health professionals. Dallas TX: American Heart Association.

3. International Association of Fire Fighters and the International Association of Fire Chiefs [1997]. The fire service joint labor management wellness/fitness initiative. International Association of Fire Fighters, Department of Occupational Health and Safety, Washington DC.

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 Edition. New York: McGraw-Hill. pp. 228-233.

5. AHA [1998]. AHA Scientific Position, Risk Factors for Coronary Artery Disease. Dallas, TX: American Heart Association.

6. Jackson E, Skerrett PJ, and Ridker PM [2001]. Epidemiology of arterial thrombosis. In: Coleman RW, Hirsh J, Marder VIJ, et al. eds. Homeostasis and thrombosis: basic principles and clinical practice. 4th edition. Philadelphia: Lippincott Williams and Wilkins.

7. Libby P [2001]. The pathogenesis of atherosclerosis. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, eds. Harrison's principles of internal medicine. 15th Edition. New York: McGraw-Hill. p.1378.

8. Shah PK [1997]. Plaque disruption and coronary thrombosis: new insight into pathogenesis and prevention. Clin Cardiol 20 (11 Suppl2): II-38-44.

9. 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.

10. Gledhill N, Jamnik, VK [1992]. Characterization of the physical demands of firefighting. Can J Spt Sci 17:3 207-213.

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. NFPA [2003]. Standard on comprehensive occupational medical program for fire departments. Quincy MA: National Fire Protection Association. NFPA 1582.

15. NFPA [2000]. Standard on medical requirements for fire fighters and information for fire department physicians. Quincy MA: National Fire Protection Association. NFPA 1582.

16. Gibbons RJ, Balady GJ, Bricker JT, Chaitman BR, Fletcher GF, Froelicher VF, Mark DB, McCallister BD, Mooss AN, O'Reilly MG, Winters WL Jr, [2002]. ACC/AHA 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). American College of Cardiology Web site. Available at: www.acc.org/clinical/guidelines/exercise/dirIndex.htm.

17. U.S. Department of Transportation [1987]. Medical advisory criteria for evaluation under 49 CFR Part 391.41 (http://www.fmcsa.dot.gov/rulesregs/fmcsr/medical.htm). Conference on cardiac disorders and commercial drivers - FHWA-MC-88-040, December. Available at http://www.fmcsa.dot.gov/Pdfs/cardiac.pdf. Accessed May 2002.

18. U.S. Preventive Services Task Force [1996]. Guide to clinical prevention services, 2nd Ed. Baltimore, MD: Williams & Wilkins, pp. 3-15.

19. American Diabetes Association [2002]. Position Statement: Diabetes mellitus and exercise. Diabetes Care 25:S64.

20. NFPA [2000]. Standard on health-related fitness programs for fire fighters. Quincy MA: National Fire Protection Association. NFPA 1583.

21. 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.

22. 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. JOEM 42:1148-1155.

23. Aldana SG [2001]. Financial impact of health promotion programs: A comprehensive review of the literature. Am J Health Promot 15:296-320.

24. Unpublished data [1997]. City Auditor, City of Phoenix, AZ. Disability retirement program evaluation. Jan 28, 1997.

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