



Captain Suffers Sudden Cardiac Death During Physical Fitness Evaluation - Alabama

SUMMARY

On April 25, 2007, a 56-year-old male career Captain was participating in the Fire Department's annual "Fit Check" (physical fitness) evaluation. The Captain successfully completed the bench press, sit-ups, and sit-and-reach portions of the evaluation within the allotted time. During the aerobic capacity (3-mile walk) portion of the evaluation, he completed 6 of 12 laps around the ¼-mile track, when he suddenly collapsed. Crew members on the scene responded and found him unresponsive, not breathing, and with a weak pulse that stopped shortly thereafter. Approximately 29 minutes later, despite cardiopulmonary resuscitation (CPR) and advanced life support administered on-scene and at the hospital, the Captain died. The death certificate and the autopsy, completed by the County Medical Examiner, listed "complications of atherosclerotic cardiovascular disease" as the immediate cause of death with "cardiomegaly" as a significant condition.

NIOSH investigators offer the following recommendations to address general safety and health issues. However, it is unclear if any of these recommendations would have prevented the Captain's sudden cardiac death.

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

- ***Incorporate exercise stress tests into the Fire Department's medical evaluation program.***
- ***Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatus (SCBA).***
- ***Provide exercise equipment in all fire stations.***
- ***Ensure that all members participate in the Fire Department's mandatory wellness/fitness program.***

INTRODUCTION and METHODS

On April 25, 2007, a 56-year-old male Captain lost consciousness while participating in the Fire Department annual physical fitness evaluation. Despite CPR and advanced life

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

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support administered by crew members, the Fire Department ambulance crew, and in the emergency department, the Captain died. NIOSH was notified of this fatality on April 26, 2007, by the United States Fire Administration. On May 9, 2007, NIOSH contacted the affected Fire Department to gather additional information and on June 6, 2007 to initiate the investigation. On June 25, 2007, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Alabama to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- Fire Chief
- Assistant Fire Chief
- Battalion Chief of Safety
- Fire Department Safety Officer
- Fire Department Chaplain
- Crew members
- Captain's family

NIOSH personnel reviewed the following documents:

- Fire Department policies and operating guidelines
- Fire Department physical examination protocols
- Fire Department fitness ("Fit Check") protocols
- Fire Department training records

- Fire Department annual report for 2006
- Fire Department incident report
- Emergency medical service (ambulance) incident report
- Death certificate
- Autopsy record
- Primary care provider medical records

INVESTIGATIVE RESULTS

On April 25, 2007, the Captain reported for duty at his fire station (Station 16) at 0800 hours. During the morning hours, the Captain performed station duties including paperwork and responding to a medical call for patient transport (1119 hours). The Captain, who was assigned to Rescue 16, provided basic medical care during the transport. After the call, Rescue 16 returned to their fire station and the crew ate lunch. Due to the scheduled "Fit Check" evaluation that afternoon, the Captain drank more fluids than usual.

Engine 2, Engine 9, Engine 31, Truck 2, and Rescue 16 were scheduled to perform their annual "Fit Check" at 1330 hours. A total of 22 fire fighters participated in the evaluation, and 9 monitoring personnel (exercise physiologists, paramedics, and the Fire Department's Safety Officer) were available for medical and rehabilitation (water, etc.) support. Participants wore gym shorts, T-shirt, and gym shoes. The first part of the "Fit Check", conducted at the City Fitness Center, included:

- vital signs (resting heart rate and blood pressure)



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- body composition measurements (chest, abdomen, thigh, and % body fat)
- upper body strength (maximum bench press, 1 repetition)
- abdomen strength (maximum number of bent-knee sit-ups in 1 minute)
- flexibility (sit and reach beyond the toes)

Points were awarded based on tasks accomplished and the participant's age. The Captain scored 50 points on body composition (poor), 75 points on upper body strength (average), 75 points on abdomen strength (average), and 80 points on flexibility (average). During the first portion of the evaluation, the Captain did not report any symptoms or show any signs of heart problems.

The "Fit Check" participants drove to the track for the aerobic portion of the evaluation. The aerobic portion consisted of either a 1½-mile run or a 3-mile walk on an oval paved track (1 lap equaled ¼-mile). The Captain selected the 3-mile walk (12 laps) which must be completed within 47 minutes for a passing score. Roll call was performed, and participants were asked by the Safety Officer if anyone felt they should not, or could not, participate in the walk/run; no one declined. The Safety Officer briefed participants that cold water was available and that two paramedics (Rescue 27) were available with medical equipment if needed. The weather conditions at this time included a temperature of about 79° F, with 44% relative humidity.¹

Table 1 shows the Captain's lap times.

Table 1: Lap Times During the Captain's 3-mile "Fit Check" Walk

Lap 1: 3 minutes and 30 seconds
Lap 2: 7 minutes
Lap 3: 10 minutes and 30 seconds
Lap 4: 13 minutes and 50 seconds
Lap 5: 17 minutes and 17 seconds
Lap 6: 21 minutes and 29 seconds
Lap 7: collapsed

The Captain was given a cup of water on lap 5 and was sweating a moderate amount. A monitor asked the Captain if he was okay, to which the Captain nodded and said "yes." The Captain chatted with other crew members and did not show any unusual signs of distress. As the Captain was three-fourths of the way through Lap 7, he struggled to breathe, and then suddenly collapsed (1438 hours).

Crew members responded immediately and found him unresponsive, not breathing, and with a weak pulse that stopped shortly thereafter. Fire Alarm was notified. CPR (assisted ventilations provided with a bag-valve-mask) was begun as a cardiac monitor was attached, revealing ventricular fibrillation (a heart rhythm incompatible with life). The Captain was defibrillated (shocked) once; his heart rhythm reverted to asystole (no heart beat). Chest compressions were begun, an intravenous line was placed, and intravenous medications consistent with advanced life support were administered. Intubation (breathing tube inserted into the trachea) was attempted without success.



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The Captain was placed onto a stretcher and into Rescue 27, which departed the scene at 1442 hours. During the transfer, the intravenous line pulled out. A second intubation attempt in Rescue 27 was successful, and cardiac resuscitation medications were administered via the endotracheal tube. En route, advanced life support procedures and CPR continued. Rescue 27 arrived at the hospital at 1446 hours. Inside the Emergency Department, CPR and advanced life support measures continued until 1507 hours, when the Captain was pronounced dead by the attending physician.

Medical Findings. The death certificate and autopsy, completed by the County Medical Examiner on April 26, 2007, listed “complications of atherosclerotic cardiovascular disease” as the immediate cause of death with “cardiomegaly” as a significant condition. Pertinent findings from the autopsy included:

- Atherosclerotic coronary artery disease (CAD)
 - Severe (95%) focal narrowing of the circumflex coronary artery
 - Moderate (50%) focal narrowing of the left anterior descending coronary artery
 - Moderate (50%) focal narrowing of the right coronary artery
- Intramural scar of the posterior wall consistent with a remote (old) myocardial infarction (heart attack)
- Myocardial bridging of the distal left anterior descending and marginal branch of the circumflex coronary arteries

- Cardiomegaly (heart weighed 490 grams [g]) (normal weight is <400 g)²
- No “obvious significant left ventricular hypertrophy”
- No evidence of a pulmonary embolus (blood clot in the lung arteries)
- Negative drug and alcohol tests

The Captain was 73 inches tall and weighed 241 pounds, giving him a body mass index (BMI) of 31.79. A BMI >30.0 kilograms per meters squared (kg/m²) is considered obese.³ The Captain had a history of hypertension and was prescribed an antihypertensive medication. Although his blood cholesterol level was normal, his cholesterol/HDL ratio had been high (> 5.77) since 1998.

In 2002, the Captain was referred to a cardiologist due to chest discomfort and shortness of breath on exertion. An imaging stress test (cardiolite single photon emission computed tomography [SPECT] study) was conducted using the Bruce protocol.⁴ The Captain exercised for 10 minutes, 12 seconds (10 metabolic equivalents [METs]) reaching a peak heart rate of 156 beats per minute (92% of his maximum). No ischemic ST-T wave changes were seen during exercise, nor were any perfusion defects identified (e.g., no evidence of ischemia or scar formation). Doppler echocardiography revealed normal heart valves, normal left ventricular ejection fraction (60%), and borderline/mild left ventricular hypertrophy. The cardiologist diagnosed the Captain as having Stage I hypertension, currently without antihypertensive therapy, and mild left ventricular hypertrophy.



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According to his family and crew members, since 2002 the Captain had no complaints of chest pains, unusual shortness of breath on exertion, or any other heart-related illness.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, the Fire Department consisted of 647 uniformed personnel and served a population of 242,000 residents in a geographic area of 165 square miles. There are 31 fire stations. Fire fighters work the following schedule: 24-hours on-duty, 48-hours off-duty, from 0800 hours to 0800 hours.

In 2006, the Fire Department responded to 51,690 calls: 31,959 advanced life support calls, 10,544 basic life support calls, 9,134 fire calls, and 53 fire/medical calls. The day prior to the incident, the Captain ran errands and worked at a charity golf event.

Employment and Training. The Fire Department requires all new fire fighter applicants to pass a written test, a Job Task evaluation (described below), an interview, a physical examination, and a drug screen prior to being hired. New fire fighter applicants are also given a fitness evaluation. Newly hired fire fighters are then sent to the 18-week fire fighter training course at the City Fire Academy to become certified as a Fire Fighter I and II, emergency medical technician (EMT) and to the Hazardous Materials (HazMat) operations level.

Recruits must complete monthly training modules for one year. The recruit training

program is based on the State minimum requirement for fire fighter certification. Recurrent training occurs daily on each shift. There is no State requirement for fire fighter re-certification. Annual re-certification is required for Hazardous Materials, while biannual re-certification is required for Apparatus/Operator and EMT/Paramedics. The Captain was certified as a Fire Fighter II, Fire Officer II, Fire Service Instructor I, Driver/Operator, EMT-Paramedic, and HazMat Technician. He had 23 years of firefighting experience.

Pre-placement Medical Evaluations. The Fire Department requires a pre-placement medical evaluation for all new hires, regardless of age. Components of this evaluation include the following:

- A complete medical history
- Physical examination (including vital signs)
- Complete blood count with lipid panel
- Pulmonary function test (PFT)
- Audiogram
- Vision screen
- Urinalysis
- Urine drug screen
- Resting EKG
- Chest x-ray (baseline)
- Mantoux tuberculosis (TB) test
- Hepatitis B Titer (if previously immunized)

These evaluations are performed by a physician contracted by the City. Once this evaluation is complete, the contracted physician makes a determination regarding medical clearance for firefighting duties and



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forwards this decision to the City's personnel director.

Periodic Medical Evaluations. Periodic (annual) medical evaluations are not required by the Fire Department for all fire fighters, only for fire fighters with City health insurance. For fire fighters with City health insurance, the annual medical evaluation can be performed by the fire fighter's personal physician or the City's contract physician. The components of this evaluation depends on who conducts the evaluation:

Good Health Program

- Blood pressure
- Blood work
- Height, weight, BMI
- Pulmonary function test
- Hearing
- Vision

Personal Physician

- Unknown

Regardless of which physician performs the evaluation, the Fire Department does not require a medical clearance for full duty.

WELLNESS and HEALTH

"Fit Check" Evaluation. A "Fit Check" evaluation is performed prior to the annual Job Task evaluation. Components of the "Fit Check" include:

- Height, weight, vital signs (blood pressure <150/100 millimeters of mercury [mmHg])

- Body composition
- Upper body strength (bench press: maximum weight, 1 repetition)
- Abdomen strength (sit-ups performed in 1 minute)
- Flexibility (sit and reach)
- Aerobic capacity/cardiorespiratory endurance (timed 1½-mile run or a 3-mile walk)
- Lifestyle assessment
- Nutrition assessment

A member who cannot perform the "Fit Check", fails to complete any component, does not achieve an average score of 75% on the first four components, or does not achieve 75% on the cardiovascular component (walk/run) is rescheduled for another "Fit Check" evaluation in about 2 weeks. If a fire fighter fails to achieve an average score of 75% on the follow-up evaluation, the City Fitness Director and the Fire Department Training/Safety Division will develop a program for the fire fighter that will strengthen areas of physical deficiency. These members are re-evaluated every month until an average score of 75% is achieved. An evaluation by the Medical Services Unit may be required for members who fail to make improvement. Members who fail to pass on their targeted date or fail to make expected improvements in meeting their goals are scheduled for a hearing with the Occupational Health and Safety Committee.

Members with a systolic blood pressure of 150 mmHg and above, or a diastolic blood pressure of 100 mmHg and above, are not allowed to participate in the "Fit Check" or engage in emergency operations and are placed on sick



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leave. The Training/Safety Division provides the fire fighter with a medical release form to be completed by the member's personal physician, stating the member is capable of performing firefighting duties. The medical release form must be submitted to the Safety Division prior to returning to full duty. As recommended by the Fire Department Safety Officer, an evaluation by the Medical Services Unit may be required.

Job Task Evaluation. The Job Task evaluation is completed with the participant wearing full bunker gear. The Job Task evaluation consists of:

- **Hose hoist:** While standing on the ground, the participant hoists one section of 1¾-inch hose to the fourth story of the drill tower utilizing a fixed pulley, lowers the hose to the ground, and then repeats the procedure within 1 minute, 15 seconds.
- **Hose pull:** The participant places the 3-inch uncharged hose nozzle on their shoulder and pulls the 3-inch hose from a starting point until the nozzle crosses the finish line, 150-feet away, within 35 seconds.
- **Dummy (manikin) drag:** The dummy is lying on the ground with the head toward the finish line and the participant behind the start line. The participant assumes a position over the dummy with the participant's arm under the dummy's arms. The participant pulls the dummy 50-feet until the dummy's head crosses the back of the finish line within 30 seconds.

- **Hydrant evolution:** The participant must uncap the hydrant, and then attach the 3-inch hose to the hydrant. The hydrant is then fully opened and then closed. The hose is disconnected and the cap is replaced on the hydrant, all within 2 minutes, 10 seconds.
- **Tower climb:** The participant dons an SCBA (without the facepiece) and places a standpipe package, consisting of two sections of 1¾-inch hose, on one shoulder. At the starting line, the participant climbs the outside stairs of the drill tower to the fifth floor and places the standpipe package in the fifth floor window. The participant then climbs the ladder to the roof of the tower and climbs down the roof ladder to the interior of the fifth floor. The participant then goes to the fifth floor window, places the standpipe package back on one shoulder, goes down the interior stairs, and exits the first floor doorway, all within 3 minutes, 30 seconds.

To pass the Job Task, the fire fighter must complete all tasks within the allotted comprehensive time of 11 minutes, 15 seconds. If a fire fighter cannot perform or fails to complete any component of the Job Task evaluation in the allotted time, he/she is rescheduled for another Job Task evaluation in about 2 weeks. Personnel who fail the Job Task evaluation two times are placed on administrative assignment to the Safety/Training Division and are required to enter a physical performance rehabilitation program conducted by the City Fitness Center Director. These members are not permitted to



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engage in emergency operations. Line personnel failing the Job Task after completing a work hardening program, or failing a third time, remain on administrative assignment pending a determination whether they may return to emergency operations. This determination is based on evaluations by the City Physician and/or Fitness Director.

If an employee is injured at work, they are placed on Injured With Pay (IWP) and under the care of the City Physician. If an employee is ill or has an injury that is not job related and off work for more than one 24-hour shift (or more than three occurrences within 12 months), the employee must be evaluated by his/her personal physician. Fire fighters assigned to operations who are returning from an extended leave of 30 days or more may be required to be evaluated by the Medical Services Unit, and successfully complete a Job Task evaluation and/or Fit Check prior to returning to regular duties. An employee may be required to provide a proof of illness form if sick leave abuse is suspected. Light duty positions are available for employees who have been ill or injured and obtain a medical release from their personal physician. If the fire fighter is incapable of returning to firefighting duties, he/she is re-assigned to a non-emergency position within the City system (contingent on availability). Exercise (strength and aerobic) equipment is located in 24 of the 30 fire stations. Fire fighters also have access to the City Health and Fitness Center. The Fire Department maintains a mandatory, on-duty wellness/fitness program, however, participation is less than 100%. Health maintenance programs are also available from the City.

DISCUSSION

The Captain's sudden cardiac death is probably related to one or more of the following conditions:

- 1) Atherosclerotic coronary artery disease (CAD)
- 2) Myocardial bridging
- 3) Mild left ventricular hypertrophy
- 4) Cardiomegaly
- 5) Physical exertion associated with the "Fit Check"

In the United States, atherosclerotic CAD is the most common risk factor for cardiac arrest and sudden cardiac death.⁵ Risk factors for its development include age over 45, male gender, family history of CAD, high blood pressure, high blood cholesterol, obesity, physical inactivity, and diabetes.⁶⁻⁷ The Captain had four of these risk factors (age over 45, male gender, hypertension, and mild obesity).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.⁸ However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.⁹ 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.¹⁰ This sudden blockage is primarily due to blood clots (thromboses) forming on the top of atherosclerotic plaques.

Establishing the occurrence of a heart attack requires any of the following: characteristic EKG changes, elevated cardiac enzymes, or



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coronary artery thrombus. In the Captain's case, he never regained a heart rhythm on which an EKG could reveal characteristic changes, cardiac enzyme testing was not performed (but the enzymes do not become positive for at least 4 hours post-heart attack),¹¹ and no thrombus was found at autopsy. However, not all heart attacks have an associated coronary artery thrombus. Given the autopsy findings of severe focal CAD and a posterior wall scar consistent with a remote (old) heart attack, it is possible the Captain suffered another "silent" heart attack. The lack of chest pain does not rule out a heart attack because in up to 20% of individuals, the first evidence of CAD may be myocardial infarction or sudden death.^{8,12}

Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.¹³⁻¹⁶ The Captain had completed the Fitness Center portion of the "Fit Check" and half of the 3-mile walk. This activity expended about 4-6 METs, which is considered moderate physical activity.¹⁷⁻¹⁹ Given the Captain's underlying CAD, the physical stress of performing the "Fit Check" evaluation could have triggered a heart attack, causing his subsequent cardiac arrest and death.

Myocardial Bridging. Myocardial bridging is defined as occurring when a portion of a coronary artery tunnels into the myocardium, creating a muscle-bridge overlap. Myocardial bridging is very common. It has been reported in 0.5% to 16% of angiographic studies, and 15% to 85% of autopsies.²⁰ Compression of the coronary artery due to the muscular band occurs during systole, and sometimes extends into diastole. Myocardial bridging has been

associated with sudden cardiac death,²¹⁻²⁴ ischemia,²⁵⁻²⁷ myocardial infarction,²⁸⁻³² arrhythmia,³³⁻³⁵ and coronary artery spasm.³⁶ Because myocardial bridging is a relatively common finding at autopsy, its role in triggering the Captain's sudden cardiac death is unclear.

Left Ventricular Hypertrophy and Cardiomegaly. On autopsy, the Captain had an enlarged heart. This enlargement was probably due to his mild left ventricular hypertrophy diagnosed by echocardiogram in 2002. The echocardiogram described his left ventricular hypertrophy as "concentric;" a finding consistent with his long standing high blood pressure. Left ventricular hypertrophy and cardiomegaly are both associated with an increased risk of sudden cardiac death.^{2, 37-39}

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of heart attacks and sudden cardiac arrest among fire fighters, the NFPA has developed guidelines entitled "*Standard on Comprehensive Occupational Medical Program for Fire Departments*," otherwise known as NFPA 1582.⁴⁰ NFPA recommends annual medical evaluations to include an EKG. Had an EKG been conducted as part of a Fire Department annual medical evaluation over the past five years, perhaps the Captain's left ventricular hypertrophy would have been detected. This may have led to further medical evaluation and treatment.

In addition to screening for risk factors for CAD, NFPA 1582 recommends conducting stress tests on members over the age of 45 with two or more CAD risk factors (hypercholesterolemia, hypertension, smoking,



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diabetes mellitus, or family history or premature CAD).⁴⁰ These recommendations are similar to those of the American College of Cardiology (ACC)/American Heart Association (AHA).⁴¹ The Captain had one current “NFPA” risk factor for CAD (hypertension) but had previously smoked, quitting in 2002. Therefore, he would have met the criteria prior to 2002, and regular stress testing would have been appropriate. Although stress tests are not required by this Fire Department, the Captain did have an imaging stress test performed by his private physician in 2002, which was reported as “unremarkable for reversible ischemia.”

RECOMMENDATIONS

NIOSH investigators offer the following recommendations to address general safety and health issues. However, it is unclear if any of these recommendations would have prevented the Captain’s sudden cardiac death.

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

NFPA 1582 requires fire departments to conduct pre-placement and annual medical evaluations to ensure fire fighters are medically capable of fire fighting duties. Guidance regarding the content and frequency of these evaluations can be found in NFPA 1582⁴⁰ and in the International Association of Fire Fighters (IAFF)/International Association

of Fire Chiefs (IAFC) *Fire Service Joint Labor Management Wellness/Fitness Initiative*.⁴² However, the Fire Department is not legally required to follow this standard or this initiative. Nonetheless, we recommend the City and Union work together to establish the content in order to be consistent with the above guidelines. Chapters 8-7.1 and 8-7.2⁴³ of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, address the economic issues. To overcome the financial obstacle, the Fire Department could urge current members to get annual medical clearances from their private physicians. This clearance would then be reviewed by the City physician, who would make the final determination of medical clearance.

Recommendation #2: Incorporate exercise stress tests into the Fire Department’s medical evaluation program.

NFPA 1582, the IAFF/IAFC *Fire Service Joint Labor Management Wellness/Fitness Initiative*, and the ACC/AHA recommend an exercise stress test for fire fighters with two or more CAD risk factors.⁴⁰⁻⁴² The exercise stress test could be conducted by the fire fighter’s personal physician or the City contract physician. If the fire fighter’s personal physician conducts the test, the results must be communicated to the City physician, who should be responsible for decisions regarding medical clearance for firefighting duties.

Had a symptom-limiting exercise stress test been performed and the Captain’s underlying cardiac disease been identified, further evaluated, and treated, perhaps his sudden cardiac death could have been prevented at this time.



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Recommendation #3: Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatus (SCBA).

The Occupational Safety and Health Administration (OSHA)'s *Revised Respiratory Protection Standard* requires employers to provide medical evaluations and clearance for employees using respiratory protection.⁴⁴ These clearance evaluations are required for private industry employees and public employees in States operating OSHA-approved State plans. Alabama is not a State-plan State; therefore, public sector employers are not required to comply with OSHA standards. However, we recommend following this standard for safety reasons, and a copy of the OSHA medical checklist has been provided to the Fire Department. This clearance should not involve any additional expense for the Fire Department.

Recommendation #4: Provide exercise equipment in all fire stations.

Currently, 24 of the fire stations have strength and aerobic exercise equipment. Also, fire fighters have access to the City Health and Fitness Center. We applaud the City for these facilities. However, NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Fighters*, recommends providing exercise equipment through the contracted use of a public gym or other facility, or placing the equipment directly in all fire stations.⁴⁵ Contracting the use of a facility requires a company (engine, ladder, etc.) of fire fighters to exercise at the same time daily at a location separate from their fire station. The gym should be centrally located, but due to

emergency responses and daily work duties, the facility may not be convenient and thus, underutilized. The fire companies may also have to be taken out of service during the time of exercise, depending on the location of the facility. Even though this Fire Department has a mandatory wellness/fitness program, fire companies are not taken out of service (due to staffing levels) to participate in the program. Locating the equipment in the fire stations allows the fire fighters to exercise within the constraints of their daily work schedules and emergency responses, while remaining more readily available for response.

Recommendation #5: Ensure that all members participate in the Fire Department's mandatory wellness/fitness program.

Physical inactivity is the most prevalent modifiable risk factor for CAD in the United States. Physical inactivity, or lack of exercise, is associated with other risk factors, including obesity and diabetes.⁴⁶ We applaud the Fire Department for developing a written, mandatory wellness/fitness program. However, compliance with the policy is not universally applied. Guidance for implementation and components of a wellness/fitness program are found in NFPA 1583,⁴⁵ in the IAFF/IAFC's *Fire Service Joint Labor Management Wellness/Fitness Initiative*,⁴² and NFPA 1500.⁴³ Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.⁴⁷⁻⁴⁹ Health promotion programs in the fire service have been shown to reduce CAD risk factors and improve fitness levels, with mandatory programs showing the most benefit.⁵⁰⁻⁵² One mandatory program was able to show a cost



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savings of \$68,741 due to reduced absenteeism.⁵³ A similar 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 their disability pension costs.⁵⁴

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