



## **Fire Captain Suffers Sudden Cardiac Death during a Live-Fire Training Exercise – North Carolina**

### **SUMMARY**

In January 2003, a 50-year-old male fire Captain requested, and received a transfer to a new Engine company (E-30). The company's Battalion Chief (BC-3) had not previously supervised the Captain and, among other things, he wanted to assess the Captain's skills as incident commander during a fire. In early January 2003, a residential property became available for a live-burn, and the exercise was scheduled for January 25, 2003 at 1330 hours. On January 23, BC-3 informed the Captain about the training and its purpose. On January 25<sup>th</sup>, the Captain and his crew began their 24-hour shift at 0800 hours. There were no alarms or response calls prior to the scheduled training. After eating lunch, the Captain and his crew of three fire fighters arrived at the property and were briefed on the exercise and took a quick tour of the house. After support crews prepared the house and laid safety and protection hose lines, E-30 backed down the street.

At 1330 hours, the drill began and the Engine pulled in front of the house. The Captain gave assignments and then exited the cab portion of the truck in bunker gear with his self-contained breathing apparatus (SCBA), and SCBA mask over his face. He proceeded to the rear of the truck, where he began to have breathing problems. After being helped out of this SCBA and turnout gear, he collapsed.

An ambulance was called, while two on-scene crew members/paramedics started cardiopulmonary resuscitation (CPR) as the other on-scene fire fighters retrieved the Engine's automated external defibrillator (AED). Unfortunately, the AED did not detect a shockable rhythm and CPR continued until the ambulance arrived approximately six minutes later. Despite advanced life support (ALS) administered on-scene,

in the ambulance, and in the hospital's emergency department (ED), the Captain died. The County Medical Examiner completed both the death certificate and autopsy report which listed "acute myocardial infarction" (heart attack) as the cause of death due to "coronary atherosclerosis" with a "prior myocardial infarction" being a significant contributing factor.

Other agencies have proposed a three-pronged strategy for reducing the risk of on-duty sudden cardiac death among fire fighters. This strategy consists of: 1) minimizing physical stress on fire fighters; 2) screening to identify and subsequently rehabilitate high risk individuals; and 3) encouraging increased individual physical capacity. Issues relevant to this Fire Department (FD) include:

- ***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 **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](http://www.cdc.gov/niosh/firehome.html)

or call toll free **1-800-35-NIOSH**



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- *Consider incorporating exercise stress tests (EST) into the annual medical evaluation for fire fighters with multiple risk factors for coronary artery disease (CAD).*
- *Annual medical evaluations should be conducted 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 National Fire Protection Association (NFPA) 1582.*
- *Following an injury/illness, the final determination of a fire fighter's return-to-work status should be made by the fire department physician after requesting, receiving, and reviewing all relevant medical information.*
- *Fire fighters should be medically cleared prior to participating in the FD's Physical Fitness Qualification (PFQ) test, specifically, the aerobic capacity (treadmill) test.*

Although unrelated to this fatality, the FD should consider these three additional recommendations based on safety considerations.

- *Provide fire fighters with medical evaluations and clearance to wear SCBA as required by the Occupational Safety and Health Administration (OSHA).*
- *Complement the impressive mandatory fitness program with a mandatory, rather than voluntary, wellness program.*
- *During live-fire training, ensure all components of NFPA 1403, Standard on Live Fire Training Evolutions, are followed.*

**INTRODUCTION AND METHODS**

On January 25, 2003, a 51 year-old male Fire Captain collapsed during the first few minutes of a live-fire training exercise. NIOSH was notified of this fatality in February 2003 by the United States Fire Administration and the Office of the State Fire Marshal – North Carolina. On June 29, 2004, an occupational medicine physician from the NIOSH Fire Fighter Fatality Investigation Team and a fire-rescue safety specialist from the Office of the State Fire Marshal office traveled to the FD to conduct an onsite investigation of the incident.

During the investigation NIOSH personnel met with and interviewed the:

- Fire Chief, Deputy Fire Chiefs, and FD Safety and Health Officer
- Crew members, Fire Officers, and other Fire Fighters present at the live-fire training exercise
- Local President and Secretary of the International Association of Fire Fighters (IAFF)
- Member of the fire Captain's family
- Contract occupational medicine physician for the FD

During the site-visit NIOSH personnel also reviewed the:

- Fire Department policies and operating guidelines
- Witness statements from FD members present at the live-fire training
- Captain's training records
- Captain's sick leave records
- Captain's physical fitness qualification reports
- Emergency medical services - ambulance report
- Death certificate
- Autopsy
- Captain's medical records

**INVESTIGATIVE RESULTS**

***Incident.*** In December 2002, the Captain requested, and in January 2003 he received, a transfer to the



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Engine crew in station 30 (E-30). Since the Captain and station 30's Battalion Chief (BC-3) had never worked together, BC-3 wanted to assess the Captain's incident command skills during a live-fire training exercise. In early January 2003, a residential property became available for a live-burn, and the exercise was scheduled for January 25, 2003.

On January 23, BC-3 informed the Captain about the training and its purpose. BC-3 did not expect the Captain to enter the structure or do any heavy physical exertion (pulling hose, etc). He told the Captain that he just wanted to become familiar with the Captain's management style, his ability to manage incoming companies by giving assignments, and maintain good command presence using basic incident command procedures.

A few days prior to the live-burn, the BC and several of the live-burn instructors planned the event with final arrangements made during the morning of Saturday, January 25 in Station 10. The scenario was a 1722 square foot two-bedroom fire in a wood frame dwelling with wood siding. The fire flow requirements would be 574 gallons per minute for total involvement. Three hydrants were nearby and each one individually had the capacity to deliver more than 790 gallons per minute. One of the hydrants had been tested in 2001, while the other two had been tested in 2002. Engine 10 (E-10) would provide back-up support and established a hydrant supply line with 200 feet of a 2 ½ inch hose. Water supply from E-10 would consist of another 100 feet of a 2 ½ inch line with a gated wye attachment from which a 1 ¾ inch charged line was advanced to the rear of the structure. Rescue 10 (R-10) would ignite the pallets in the bedroom, and assist E-30 with the fire attack. E-30 would attack the fire with the Captain being the incident commander. As E-30 arrived on-scene they would be expected to drop a 5 inch hose to the hydrant, and then supply two 1 ¾ inch hose lines to the front of the house. These two lines would

be used by the attack teams from E-30 and R-10. BC-3 would be the lead instructor, and Car 25 was the site Safety Officer and "dispatcher." In total there were 15 fire fighters on-scene, three of which were live-fire instructors. There were a total of two engines, one rescue truck, and two FD cars on-scene.

On January 25, 2003, E-30 (composed of three Fire Fighters and their Captain) began their 24-hour shift at 0800 hours. It was a weekend (Saturday), and the morning was spent performing light duties (station maintenance, and equipment inspections). During the morning BC-3 informed the Captain of the start time of the exercise (1330 hours). The crew did not respond to any calls during the morning, ate lunch at approximately 1200 hours, and arrived at the live-burn area at 1325 hours. BC-3 briefed the E-30 crew about the exercise after which they took a quick tour of the house. E-30 then backed down the street to the staging area awaiting their "dispatch."

At 1330 hours, the drill began and E-30 pulled in front of the house. One crew member connected to the hydrant while the two other fire fighters pulled the attack lines toward the front of the house. Upon arrival, the Captain gave assignments to two imaginary companies for ventilation, suppression, and rapid intervention. He then exited the cab portion of the truck in full bunker gear, donned his SCBA, and strapped the SCBA mask to his face. He proceeded to the rear of the truck, where a bystander noted he was leaning forward with his hands on his thighs and asked "Is that fellow okay?" BC-3 approached the Captain who seemed to be having trouble removing his SCBA mask. BC-3 assisted by taking the mask off and the Captain stated he was having trouble breathing and that he could not catch his breath. BC-3 then yelled for some assistance as he helped the Captain remove his air pack and turnout gear. Just as they were able to get his turnout coat around his elbows, he collapsed.



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BC-3 eased the Captain to the ground and yelled for one of the fire fighters to bring the medical equipment (AED, oral airway, and oxygen equipment) from the Engine. BC-3 then called R-10 to put out the fire, and called dispatch at 1338 hours for a paramedic unit (ambulance) due to a fire fighter with chest pains. The safety officer did a quick assessment of the Captain who was still conscious with labored breathing. He placed a non-rebreathing mask over the Captain's nose and mouth when two on-scene firefighters certified as emergency medical technicians with defibrillation capability (EMT-d) from E-30 and E-10 came to assist. A few seconds later the Captain's breathing deteriorated, then his pulse became weak and stopped. CPR was started as the AED pads were attached to the Captain's chest. Unfortunately the AED advised no shock (due to a heart rhythm being present that does not respond to defibrillation). CPR continued as an oral airway was placed and oxygen was administered via a bag-valve-mask.

The ambulance arrived at 1344 hours (approximately six minutes since his collapse). The paramedics found the Captain unresponsive with no pulse or spontaneous respirations. He was placed on a backboard, packaged, and loaded into the ambulance. ALS procedures were initiated [intubation (a breathing tube placed into the victim's windpipe with placement confirmed by end-tidal CO<sub>2</sub> testing) and the insertion of an intra-venous [IV] line for the administration of cardiac medications]. En-route to the hospital the cardiac monitor suggested ventricular fibrillation and over the 15 minute travel time to the hospital three shocks were delivered to the Captain without a successful change in the heart rhythm. The medic unit arrived at the local hospital's ED at 1405 hours. ALS procedures were continued for an additional five minutes in the ED when the Captain was pronounced dead (approximately 30 minutes after his collapse) and resuscitation efforts were discontinued.

The Captain did not report any symptoms such as chest pain or shortness of breath the morning before of the training exercise. He did, however, express anxiety and nervousness about his performance during the live-fire training exercise scheduled for that afternoon to not only his crewmembers, but also family members.

Because of his severe shortness of breath shortly after donning his SCBA, the entire ensemble was sent to NIOSH's laboratories in Pittsburgh, PA for testing. A comprehensive evaluation was conducted. Other than a low-air alarm bell not meeting requirements, the SCBA successfully completed all other tests.

***Medical Findings.*** The County Medical Examiner completed both the death certificate and autopsy report. The death certificate listed "acute myocardial infarction" (heart attack) as the cause of death due to "coronary atherosclerosis" with a "prior myocardial infarction" being a significant contributing factor. The autopsy was significant for:

Severe atherosclerotic coronary artery disease:

- 100% blockage of the right coronary artery
- 100% blockage of the circumflex coronary artery
- 100% blockage of the first diagonal coronary artery in the area of the stent (called the ramus intermedius artery by the Captain's treating cardiologist)
- A seven centimeter scar (due to his heart attack in 1999) in the posterior and lateral left ventricular wall
- A two centimeter hyperemic area near the first diagonal coronary artery which probably represented the early signs of a recent (acute) heart attack (myocardial infarction)

Carboxyhemoglobin level was less than 5% suggesting carbon monoxide exposure was not a significant factor in the Captain's sudden death.





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The Captain had risk factors for CAD (a positive family history and diabetes mellitus treated with oral agents and low fat/low cholesterol diet.) He was found to have CAD in 1999 when he experienced a heart attack in the lateral area of his heart. Emergency cardiac catheterization revealed the acute blockage of one of his coronary arteries (ramus intermedius) which was opened by a balloon (angioplasty) and remained open with the insertion of a stent. He was also found to have old occlusions (100%) of his right coronary artery, and his circumflex coronary artery (100%). There was a lack of movement in the area of the heart where his heart attack occurred (lateral hypokinesis), and mild impairment in the heart's pumping actions [left ventricular ejection fraction (LVEF) of 45%]. Fortunately, there was only minimal disease (20% blockage) in one of the largest coronary arteries known as the left anterior descending (LAD) artery.

Unfortunately, once in 2000 and again in 2001, the stented artery re-clogged (restenosed) resulting in acute symptoms (decreased exercise tolerance, shortness of breath, and chest pain). Each time the artery was opened by a balloon (angioplasty) during a cardiac catheterization, and in 2001, the vessel was also irradiated. In March 2002, the Captain experienced a fourth episode of worsening shortness of breath and chest pain, but this time the cardiac catheterization did not show restenosis of the stented artery. It did, however, find increasing LAD disease (60% blockage), a larger area of reduced heart movement (lateral and inferobasal hypokinesis), and more left ventricle dysfunction (from mild to moderate with a LVEF of 40%). It was decided to continue to treat the Captain's condition medically (e.g. with medications), although bypass surgery was discussed as a possible future intervention.

It appears the Captain had three EST (two conducted in 2000, and one in 2001). The last two tests were "adenosine" EST which chemically

increases the heart rate rather than relying on physical exertion (running). From the medical records available to NIOSH, the last adenosine EST was performed in February 2001 which was non-diagnostic due to the inability to reach 85% of the target heart rate. The imaging portion of the EST showed a small to medium predominately fixed inferolateral/lateral defect. There was only a small amount of peri-infarct ischemia noted and it appeared unchanged from the last EST in September 2000. Of considerable concern was a blood pressure drop from 142/70 to 98/60 when the heart rate increased from 70 to 93 beats per minute.

One to two months prior to his death, his daughter reported a significant decrease in his exercise tolerance, an increase in his shortness of breath, and increasing reliance of his anti-angina [sublingual nitroglycerin (NTG)] tablets.

In December, 2002, the Captain performed two treadmill tests as part of his FD's PFQ. During both tests he was unable to exercise more than one minute 45 seconds needing to stop because of dizziness. He reached a MVO<sub>2</sub> of approximately 35 ml/kg-min which corresponds to about ten metabolic equivalents (METS). The fitness coordinator recommended that the Captain be put on limited duty until an extensive medical evaluation could be conducted by the FD physician. The Captain then had a cardiologist in South Carolina write a letter stating his dizziness was probably due to a recent medication trial and he recommended a reduction in the dose and resumption of full duties. His treating cardiologist also released him to full duty after signing a statement that the Captain's condition would not preclude him from performing strenuous fire fighting duties such as climbing up to 70 floors or climbing a ladder up to 100 feet. The contracted occupational medicine physician did not object, and he was returned to full duty. Accordingly, on January 4, 2003, the Captain began work with his transfer to station 30.



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**DESCRIPTION OF THE FIRE DEPARTMENT**

At the time of the NIOSH investigation, the Fire Department was comprised of 908 uniformed personnel and served a population of 613,000 residents, in a geographic area of 268 square miles. Each engine and ladder company is staffed with an officer and at least three fire fighters. There are 35 fire stations where fire fighters work 24-hour shifts starting at 0800 hours according to the following tour: 24 hrs-on, 24-off, 24-on, 48-off, 24-on, 24-off, 24-on, 96-off. The Captain was on the last 24-hour shift of this tour. The previous afternoon he spent hunting. As mentioned earlier, his family reported during a month or two prior to his death, the Captain was having decreasing exercise tolerance, increasing use of NTG tablets, and more SOB during exertion. During the day of his collapse, the Captain did not mention any chest pain or shortness of breath to his family or crewmembers. He did, however, express that he was nervous and anxious about his performance of the upcoming live-fire training exercise.

In fiscal year 2003 (7/1/02 to 6/30/03), the FD responded to 73,036 alarms: approximately 48,000 emergency medical service, 11,000 good intent, 5,000 service calls, 2,300 HAZMAT, 2,300 fire alarms, 2,000 false alarms, 1,100 other incidents, 900 overpressure, and 40 natural disasters. The ambulance service (ALS) is provided by the County.

*Training.* The FD provides all new hires with an 18-week training course to become State-certified at the NFPA Fire Fighter II level. All are State-certified EMT-d and are certified in CPR, AED use, and hazardous materials operations level (24 hour). The victim had 24 years of fire fighting experience and during that time was promoted from a FD level FF I, to a FD level FF II, to an Engineer, then to a Captain.

*Pre-employment/Pre-placement Evaluations.*

Candidates are required to complete a Candidate Physical Ability Test; a timed performance evaluation of essential fire fighting duties.<sup>1</sup> The candidate has an opportunity to practice the CPAT up to eight weeks before their actual test. Candidates who do not complete the task within the allotted time are dropped from the Candidate hiring pool. Once hired, recruits are also required to pass a physical fitness examination administered at the beginning, middle, end of the training period, and at the end of the first year probationary period.

Candidates are also required to pass a urine drug test used to detect illicit drug use. If the Candidate passes the drug test, they undergo a pre-placement medical evaluation for all new hires, regardless of age. Components of this evaluation include:

- A complete medical history
- Height, weight, and vital signs
- Physical examination
- Blood Tests: Complete blood count (CBC), SMA 6, liver function tests, lipid test, and Hepatitis B antibody and antigen titer testing
- Urine dipstick test
- Chest X-ray
- Electrocardiogram (EKG)
- Pulmonary function tests/spirometry
- Audiometry
- Vision Test
- Tetanus booster (if appropriate)

These evaluations are performed by the FD contract physician, who makes a decision regarding medical clearance for fire fighting duties. The FD is notified of any condition requiring modification or restriction. Results of the medical examination are kept confidential by the contract physician and only the clearance status is reported to the FD.

*Periodic Evaluations* From 1980 until approximately 1992, the FD required annual medical



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examinations for fire fighters over the age of 40 years. Since 1992, however, the FD medical examinations became optional and included a \$25 to \$30 co-payment. Consequently, few fire service personnel participated in these annual medical evaluations; instead they received their medical care through their personal physicians. Hazmat personnel, on the other hand, continued to receive their annual medical examinations per the State OSHA Standard.<sup>2,3</sup>

If a fire fighter is injured at work or has missed work due to non-work-related illness for 30 or more days, he/she must be cleared for “return to work” by their treating physician(s). This clearance requires the signature of the treating physician on a FD “medical clearance form.” This form includes a “physical job description” that lists many of the physically challenging job duties required during fire suppression or rescue work. This information is then forwarded to the FD’s contracted occupational medicine physician who has the final authority regarding return to duty.

Since 1980 the FD has had a mandatory physical fitness program designed to meet the guidelines of the Joint Labor/Management Wellness-Fitness Initiative.<sup>4</sup> The program consists of an individualized exercise program developed by the Physical Fitness Coordinator based on a physical fitness evaluation. Each fire fighter is required to devote one hour to physical fitness training during each 24-hour shift (Sundays and Holidays optional). All fire stations are equipped with exercise (strength and aerobic) equipment.

The evaluation portion of the program, known as “Physical Fitness Qualification (PFQ),” requires an annual physical fitness test. The test scores fire fighters in four areas: aerobic capacity, muscle strength, flexibility, and muscle endurance. The scores are weighted to generate a total/overall score. The total score is categorized into five groups:

unacceptable, marginal, performance achieved expectations, performance exceeded expectations, and exceptional performance. The total scores needed to achieve each category are stratified by age (less than 40 years and 40 or more). If a member receives an unacceptable rating, a number of events are triggered:

1. A required counseling session with the Physical Fitness Coordinator
2. Immediate removal from operations duty assignment; assigned light duty if necessary
3. A medical examination with the FD contracted occupational medicine specialist
4. Retest within three months after clearance by the FD contracted physician

If the retest results in an unacceptable rating again, it is noted in their personnel performance appraisal and a Job-Related Physical Agility Test (JRPAT) is scheduled within one week. If the fire fighter fails the JRPAT, they are immediately removed from operations duty assignment. The Physical Fitness Coordinator reviews their exercise regimen and the fire fighter must retake the JRPAT or the PFQ within 30 days. Failure to pass either of these tests will result in suspension without pay for up to 30 days and possible termination.

## **DISCUSSION**

In the United States, coronary artery disease (CAD) is the most common risk factor for cardiac arrest and sudden cardiac death.<sup>5</sup> The Captain had several risk factors for CAD (family history, diabetes mellitus, age over 45, male gender) and had known CAD with a heart attack (myocardial infarction) in 1999.<sup>6,7</sup>

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.<sup>8</sup> This sudden blockage is primarily due to blood clots (thrombosis) forming on



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the top of atherosclerotic plaques after disruption of these plaques. The Captain appeared to have a recent occlusion of his previously stented artery on autopsy, supported by the finding of a “2 cm area in the anterior left ventricular wall that is hyperemic. This hyperemic area is located between the anterior left descending and first diagonal coronary arteries.” This hyperemic area is consistent with the recently occluded stented vessel and with progressive atherosclerotic disease noted at autopsy. This supports the evidence that a heart attack led to his sudden cardiac death.

Certain characteristics of the plaques (size, composition of the cap and core, presence of a local inflammatory process) predispose the plaque to disruption.<sup>8</sup> Disruption then occurs from biomechanical and hemodynamic forces, such as increased blood pressure, increased heart rate, increased catecholamines, and shear forces, which can occur during heavy exercise.<sup>9,10</sup> Epidemiologic studies have found that physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.<sup>11-14</sup> Although the Captain had not performed any heavy physical activity during the live-burn exercise, he was very anxious about his performance. This anxiety could have increased his heart rate which, in turn, increases the amount of work required of the heart, which could have triggered his heart attack.

To reduce the risk of heart attacks and sudden cardiac arrest among fire fighters, the NFPA has developed guidelines to help FD physicians develop screening programs and make fitness-for-duty determinations.<sup>15</sup> At the time of this fire fighter fatality, the 2000 edition of NFPA 1582 entitled “Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians” was in effect.<sup>16</sup> The 2000 edition recommends a yearly physical evaluation to include a medical history, height, weight, blood pressure, and visual acuity test.

The Standard goes on to recommend a thorough examination to include vision testing, audiometry, pulmonary function testing, and blood testing be conducted on a periodic basis according to the age of the fire fighter (less than 30: every 3 years; 30-39: every 2 years; over 40 years: every year). This FD currently does not require any type of medical evaluation or examination other than for HAZMAT employees at the technician (40 hours) level as required by OSHA.<sup>2,3</sup>

Although this FD does not require annual medical exams or screening EST, the Captain did undergo close medical and cardiac monitoring by his cardiologist. His last cardiac catheterization in March 2002 showed a mild to “moderate left ventricular dysfunction” with an ejection fraction of 40%. He was last seen by his cardiologist two weeks prior to his death at which time it was noted, the Captain had recently developed exertional angina (heart pain) with “minimal work” and “shortness of breath with moderate exercise.” In addition, “As part of the Berlex trial he was shown to have EKG changes while on the treadmill.” In addition, the aerobic capacity treadmill test performed as part of his FD’s PFQ in December 2002 showed he was only able to exercise for 1 minute 45 seconds (approximately 35 ml/kg-min or 10 METS) before stopping due to dizziness.

The 2000 edition of NFPA 1582 also provides guidance regarding medical conditions that should (Category A) or could (Category B) preclude full duty assignments. CAD or coronary angioplasty is listed as a Category B condition, defined as “a medical condition that, based on its severity or degree, could preclude a person from performing as a member in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others.” NFPA 1582 Appendix A, while included for informational purposes only and is not a part of the requirements of NFPA 1582, states the presence of “exercise-





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induced ischemia by exercise testing” would be a disqualifying condition, as would the presence of reduced left ventricular dysfunction.<sup>16</sup> Therefore, according to NFPA 1582, the Captain should not have been cleared for full duty. It is possible that a restrictive duty assignment may have prevented his sudden cardiac death at this time.

### **RECOMMENDATIONS AND DISCUSSION**

The following recommendations address health and safety generally. This list includes some preventive measures that have been recommended by other agencies to reduce the risk of sudden cardiac arrest and or death among fire fighters. These recommendations have not been evaluated by NIOSH, but represent research presented in the literature or of consensus votes of Technical Committees of the National Fire Protection Association or labor/management groups within the fire service. This strategy consists of: 1) minimizing physical stress on fire fighters; 2) screening to identify and subsequently rehabilitate high risk individuals; and 3) encouraging increased individual physical capacity. Issues relevant to this Fire Department (FD) include:

***Recommendation #1: 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 Department and Union should negotiate the content and frequency to be consistent with NFPA 1582.***

Since the FD’s mandatory annual medical examinations were discontinued in 1992, the FD has approached the City regarding resurrecting that program. The program was not restarted due to cost concerns; costs not only for the fire fighter examinations, but also the perceived need to offer similar examinations for all other City employees. It

should be remembered, however, that fire fighters are public safety employees. Their job requires entering environments that are immediately dangerous to life and health (IDLH). Sudden incapacitation in an IDLH environment not only jeopardizes the life of that individual, but also his/her peers and the civilians they have sworn to protect. Most other city employees are not operating in IDLH environments, nor do they have the physical demands of fire fighting. Providing mandatory annual medical evaluations to ensure fire fighter can safely perform their duties is consistent with their job requirements.

Guidance regarding the content and frequency of medical evaluations for fire fighters can be found in NFPA 1582,<sup>15</sup> and in the Fire Service Labor Management Wellness/Fitness Initiative.<sup>4</sup> 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.

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.<sup>17</sup> The success of medical programs may hinge on protecting the affected fire fighter. The FD should provide alternate duty positions for fire fighters in rehabilitation programs, if possible. 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 FD.

***Recommendation #2: Consider incorporating exercise stress tests (EST) into the annual medical evaluation for fire fighters with multiple risk factors for coronary artery disease (CAD).***

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NFPA 1582 and the IAFF/IAFC wellness/fitness initiative both recommend EST for some fire fighters to screen for obstructive CAD.<sup>4,15</sup> NFPA 1582 recommends EST for those fire fighters with two or more CAD risk factors. According to NFPA 1582, these CAD risk factors are:

- family history of premature [less than age 60] cardiac event,
- hypertension,
- diabetes mellitus,
- hypercholesterolemia [total cholesterol greater than 240 mg/dL or HDL cholesterol less than 35 mg/dL], and
- cigarette smoking.

These recommendations are similar (although not exactly the same) as the recommendations of the American College of Cardiology/American Heart Association (ACC/AHA).<sup>18</sup>

The EST could be conducted by the fire fighter’s personal physician or the FD contract physician. If the fire fighter’s personal physician or the contracted physician conducts the test, the results must be communicated to the FD physician, who should be responsible for decisions regarding medical clearance for fire fighting duties.

***Recommendation #3: Annual medical evaluations should be conducted by the fire department physician who is knowledgeable about the physical demands of fire fighting and the various components of NFPA 1582.***

***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 after requesting, receiving, and reviewing all relevant medical information.***

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 IDLH environments.<sup>19-21</sup> They should also be familiar with the consensus guidelines published by *NFPA 1582, Standard on Comprehensive Occupational Medicine Program for Fire Departments*.<sup>15</sup> To ensure physicians are aware of these guidelines, we recommend that the Fire Department provide the contract and other private physicians with a copy of NFPA 1582. In addition, we recommend the fire department physician consider, but not “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 department contracted physician. The final decision regarding medical clearance lies with the FD physician with input from many sources including the fire fighter’s private physician.

***Recommendation #5: Fire fighters should be medically cleared prior to participating in the FD’s Physical Fitness Qualification (PFQ) test, specifically, the aerobic capacity (treadmill) test.***

During the Captain’s PFQ, he experienced dizziness and impaired consciousness. Whether this was due to persistent ischemic heart disease (angina), or a side effect of his heart medications is unclear. However, it does point out the need for medical clearance prior to these tests. This is particularly true for the treadmill test where members can reach



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their maximum heart rates and metabolic work of up to 15 METS.

Although unrelated to this fatality, the FD should consider these three additional recommendations based on safety considerations.

***Recommendation #1: Provide fire fighters with medical evaluations and clearance to wear SCBA as required by the Occupational Safety and Health Administration (OSHA).***

OSHA's revised respiratory protection standard requires employees to provide annual medical evaluations and clearances for employees using respiratory protection.<sup>22</sup> These clearance evaluations are required for private industry employees and public employees in States operating OSHA-approved State plans. Since North Carolina is a State-plan State, public employees, including FD must comply with this Standard.

***Recommendation #2: Complement the impressive mandatory fitness program with a mandatory, rather than voluntary, wellness program. Specific programs that can reduce modifiable CAD risk factors include smoking cessation, weight control, and low fat/ low cholesterol diets.***

The International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) created the Fire Service Joint Labor Management Wellness/Fitness Initiative to strengthen fire fighters' mental, physical, and emotional capabilities.<sup>4</sup> NFPA 1583 Standard on Health-Related Fitness for Firefighters prescribes similar department-wide programs to enhance physical fitness and reduce modifiable cardiac risk factors in firefighters.<sup>23</sup> Both documents stress the importance of regular aerobic and strengthening exercise, nutrition and weight control, and smoking cessation.

Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.<sup>24,25</sup> 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.<sup>26</sup>

***Recommendation #3: During live-fire training, ensure all components of NFPA 1403, Standard on Live-Fire Training Evolutions, are followed.***

Live-fire training can be very dangerous. Since fire fighters have become injured or even died during live-fire training, the NFPA has provided guidelines to ensure a safe exercise. We recommend the FD review their live-fire training protocols to ensure all components of NFPA 1403 are being followed.

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**INVESTIGATOR INFORMATION**

This investigation was conducted in conjunction with a fire-rescue training specialist from the Office of the State Fire Marshal North Carolina. The report was written by Thomas Hales, MD, MPH of the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio. The NIOSH investigator would like to acknowledge the cooperation and assistance provided by the Office of the State Fire Marshal, the crew members and Officers of the affected FD, and the local IAFF staff.