



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

SUMMARY

On April 27, 2007, a 51-year-old male career Captain and a crew member drove to another city to attend high-rise incident command training. After checking into the hotel, he and the crew member went to eat dinner (2230 hours). After eating and visiting with friends, the Captain complained of not feeling well and wanted to return to the hotel. Outside the restaurant, the Captain collapsed. The crew member assessed him and found him unresponsive, with agonal breathing, and with a slow pulse. The crew member began assisted ventilation via mouth-to-mouth resuscitation. An ambulance responded and provided advanced life support, including cardiopulmonary resuscitation (CPR). Approximately 47 minutes later, despite CPR and advanced life support administered on-scene and at the hospital, the Captain died. The death certificate and the autopsy (completed by the Assistant Medical Examiner) listed “hypertensive and atherosclerotic cardiovascular disease” as the cause of death.

The NIOSH investigator offers the following recommendations to address general safety and health issues. Had these recommendations been in place prior to 2007, perhaps the Captain’s sudden cardiac death could have been prevented.

- *Provide mandatory annual medical evaluations to fire fighters consistent with National Fire Protection Association (NFPA) 1582 to determine their medical ability to perform 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 clearance to wear self-contained breathing apparatus (SCBA) as part of the Fire Department’s medical evaluation program.*
- *Phase-in a comprehensive wellness and fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*
- *Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are capable of performing the essential job tasks of structural firefighting.*
- *Eliminate or reduce the frequency of periodic chest x-rays in asymptomatic fire fighters, unless clinically indicated.*

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/fire
or call toll free 1-800-CDC-INFO



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

INTRODUCTION & METHODS

On April 28, 2007, a 51-year-old male Captain lost consciousness while in travel status for training. Despite CPR and advanced life support administered by a crew member, the ambulance crew, and in the emergency department, the Captain died. NIOSH was notified of this fatality on April 30, 2007, by the United States Fire Administration. On May 9, 2007, NIOSH contacted the affected Fire Department to gather additional information, and on July 26, 2007 to initiate the investigation. On September 25, 2007, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Texas to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- Fire Chief
- Crew members
- City Human Resources Office
- Captain's spouse

NIOSH personnel reviewed the following documents:

- Fire Department policies and operating guidelines
- Fire Department training records
- Fire Department annual report for 2006
- Police report
- Emergency medical service (ambulance) incident report
- Fire Department physical examination protocols
- Emergency Department record
- Death certificate
- Autopsy record
- Primary care provider medical records

RESULTS OF INVESTIGATION

Incident. On April 27, 2007, just after noon, the Captain and a crew member drove to another city to attend high-rise incident command training with other members of his Fire Department. After checking into the hotel, he learned later that afternoon that the training was cancelled. Due to the late hour of notification, the group planned to return home the next day. During telephone calls that afternoon to his wife and son, the Captain did not report any health problems or symptoms. At approximately 2230 hours, he and a crew member left the hotel via taxi to eat dinner.

After eating dinner and visiting with friends, the Captain complained of "not feeling well, having cold sweats, and wanted to return to the hotel" (approximately 0034 hours). However, he remained at the restaurant for about another hour and collapsed while awaiting a taxi (0130 hours). A police officer, patrolling in the parking lot, saw the Captain collapse. Arriving at the Captain's location, the officer noted the Captain was unresponsive, had a pale color, was sweating "uncontrollably," and was bleeding from the nose. The Captain was rolled over on his right side and paramedics were notified.

The crew member began assisted ventilations via mouth-to-mouth resuscitation. Ambulance 506 (with a paramedic and two emergency medical technicians [EMTs]) responded, arriving at the scene at 0136 hours. Assessment revealed a pulse of 52 beats per minute and six shallow breaths per minute. The Captain was placed onto a stretcher and into Ambulance 506, where CPR was begun. A cardiac monitor was attached to the Captain, revealing asystole (no heart beat). The Captain was intubated (breathing tube inserted into the trachea), and placement was confirmed



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

by auscultation and an end tidal carbon dioxide test. An intravenous line was placed, and cardiac resuscitation medications were administered. The ambulance departed the scene at 0153 hours, en route to the hospital; advanced life support procedures and CPR continued with no positive change in the Captain's condition. Ambulance 506 arrived at the hospital at 0157 hours. Inside the Emergency Department, CPR and advanced life support measures continued until 0217 hours, when the Captain was pronounced dead by the attending physician.

Medical Findings. The death certificate and autopsy, completed by the Assistant Medical Examiner on April 28, 2007, listed "hypertensive and atherosclerotic cardiovascular disease" as the immediate cause of death. Pertinent findings from the autopsy included:

- Cardiomegaly (heart weighed 500 grams [g]) (normal weight is <400 g) [Siegel 1997a]
- Atherosclerotic cardiovascular disease
Severe (95%) focal narrowing of the left anterior descending coronary artery
- Severe (90%) focal narrowing of the left circumflex coronary artery
- Severe (75%) focal narrowing of the right coronary artery
 - No evidence of a thrombus (blood clot)
- Concentric left ventricular hypertrophy (LVH)
- Left ventricle and interventricular septum walls thickened (1.5 centimeters [cm])

- normal at autopsy is 0.76-0.88 cm [Colucci and Braunwald 1997]
- normal by echocardiographic measurement is 0.6 to 1.1 cm [Armstrong and Feigenbaum 2001]
- Hypertrophic myocytes and focal interstitial fibrosis by microscope
- No evidence of a pulmonary embolus (blood clot in the lung arteries)

Positive alcohol test (0.22 grams per deciliter)

The Captain was 72" tall and weighed 237 pounds, giving him a body mass index (BMI) of 32.1. A BMI >30.0 kilograms per meters squared (kg/m^2) is considered obese [National Heart Lung and Blood Institute 2005]. He had been prescribed weight control medications since 1993. The Captain was diagnosed with high blood pressure (Stage 1 hypertension) in 2000, but was not prescribed an antihypertensive medication [JNC-7 2003]. He also had a history of high blood lipids including cholesterol and was prescribed medications and low cholesterol diets. However, since 2004 his medical records did not mention on-going follow-up of his blood lipids or medications.

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



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, the Fire Department consisted of 58 uniformed personnel and served a population of 50,000 residents in a geographic area of 50 square miles. There are five 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 2,465 calls: 1,593 rescue/EMS calls and 872 fire/ hazardous condition calls. The day prior to the incident, the Captain performed household chores at home and drove to the training city.

Employment and Training. The Fire Department requires all new fire fighter applicants to be pre-certified fire fighters who have completed a State-licensed academy and State/National Registry EMT-Basic or higher course. In addition, applicants must pass a written test, a physical ability test, an interview board, a Chief's interview, a physical examination, a psychological evaluation, a drug screen, and a background check prior to being hired. Newly-hired fire fighters are placed on day-shift for 1 month to learn administration, other City and County departments' operations, dispatch, and Standard Operating Guidelines/Standard Operating Procedures/ Emergency Medical Service protocol review; then rotated to each of the five fire stations for 1 month prior to final shift placement. At each station, members must learn all aspects of that station's operations including streets, apparatus, equipment, etc. The fire fighter remains on probation for an additional 6 months, for a total of 12 months.

The State requires a minimum of 468 hours of fire fighter training at a certified academy for fire fighter certification (International Fire Service Accreditation Congress: Fire fighter I and II, Hazardous Materials Awareness and Operations). Re-certification is required for EMTs/Paramedics every 4 years. Fire fighters are required by the State to receive 20 hours of fire fighter training annually. The Captain was certified as a Fire Fighter-Intermediate, Fire Service Instructor-Intermediate, EMT, and had 33 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
- Audiogram
- Vision screen
- Urinalysis
- Urine drug screen
- Resting electrocardiogram (EKG)
- Chest x-ray (baseline only)

These evaluations are performed by a physician contracted with the City. Once this evaluation is complete, the contracted physician makes a determination regarding medical clearance for firefighting duties and forwards this decision to the City's personnel director and the Fire Department.



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

Periodic Medical Evaluations. In 2007, the Fire Department began requiring annual medical evaluations. Components of this evaluation are the same as those of the pre-placement medical evaluation with three exceptions: the urine drug screen is not repeated, exercise stress tests are performed on all fire fighters over age 55, or exercise stress tests are performed if recommended by the Fire Department physician. The annual medical evaluation may be performed by the fire fighter's primary care physician, provided the same components are included, and the results shared with the City-contracted physician. If follow-up is required, this can be provided by the City-contracted physician or the fire fighter's personal physician. In all cases, the City-contracted physician makes the final decision regarding medical clearance for duty. Annual self-contained breathing apparatus (SCBA) medical clearance also began in 2007.

Health and Wellness Programs. In 2007, the Fire Department began a mandatory, non-punitive wellness/fitness program with 100% participation. The wellness/fitness program is overseen by a group of three peer fitness trainers as recommended by the International Association of Fire Fighters (IAFF)/International Association of Fire Chiefs (IAFC) wellness/fitness initiative [IAFF, IAFC 2000]. Exercise (strength and aerobic) equipment is located in some of the fire stations. Fire fighters are also given a local health club membership and have on-duty time to exercise. Health maintenance/wellness programs are available from the City.

In 2007, a mandatory annual fitness evaluation was also begun. Components of the fitness evaluation include:

- Muscular strength (hand grip dynamometer, leg dynamometer, and arm dynamometer)
- Muscular endurance (push-ups in 2 minutes and curl-ups in 3 minutes)
- Flexibility (sit-and-reach)
- Aerobic capacity (treadmill or stair mill)
- Body composition analysis (body fat)

Resting heart rate and blood pressure measurements are obtained prior to the aerobic capacity test. If the member's resting heart rate exceeds 110 beats per minute, or the resting blood pressure exceeds 160/100 millimeters of mercury (mmHg), these vital signs are re-checked 5 minutes later. If the heart rate or blood pressure exceeds these values again, the member is referred for medical evaluation and rescheduled for another fitness evaluation in about 2 weeks. If a fire fighter fails to pass all components of the fitness evaluation, a Fire Department Peer Fitness Trainer prescribes an individual exercise program to strengthen areas of physical deficiency. These members are re-evaluated every month until the member passes the evaluation. Members who fail to pass on their targeted date, or who fail to make expected improvements in meeting their goals, are scheduled for a meeting with the Fire Department physician.

If an employee is injured at work, or is ill and off work for two 24-hour shifts or more, the fire fighter must be evaluated by his/her personal physician. The fire fighter then provides a medical release form to his/her shift commander. The shift commander then forwards the release to the City's Human Resources Office, who makes the final determination regarding "return to work."



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

DISCUSSION

The Captain's sudden cardiac death was probably related to his atherosclerotic coronary artery disease (CAD), left ventricular hypertrophy, cardiomegaly, or any combination of these. In the United States, CAD (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death [Meyerburg and Castellanos 2005]. 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 [American Heart Association (AHA) 1998; Jackson et al. 2001]. The Captain had five of these risk factors (age over 45, male gender, hypertension, high cholesterol, and mild obesity).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades [Libby 2005]. However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion [Shah 1997]. 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 [Fuster et al. 1992]. This sudden blockage is primarily due to blood clots (thromboses) forming on top of atherosclerotic plaques.

Establishing the occurrence of a heart attack requires any of the following: characteristic EKG changes, elevated cardiac enzymes, or coronary artery thrombus. In the Captain's case, he never regained a heart rhythm on which an EKG could reveal characteristic changes, cardiac enzymes do not become positive for at least 4 hours post-heart attack and the Captain died within 1 hour after collapse, and no thrombus was found at autopsy [AHA 2006]. However, not all heart attacks have

an associated coronary artery thrombus. On autopsy, the Captain had severe narrowing of his coronary arteries with atherosclerosis. Based on the clinical scenario, the Captain probably had an acute heart attack, which caused an arrhythmia and sudden cardiac death.

The Captain did not report any episodes of chest pain (angina) during physical activity (on or off-the-job), and he did not complain of angina during this episode, only that he did not feel well. 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 [Libby 2005; Thaulow et al. 1993].

Cardiomegaly/Left Ventricular Hypertrophy.

On autopsy, the Captain had an enlarged heart. This was probably due to his left ventricular hypertrophy resulting from his longstanding hypertension. Both cardiomegaly and left ventricular hypertrophy increase the risk of sudden cardiac death.

Occupational Medical Standards for Structural Fire Fighters.

To reduce the risk of heart attacks and sudden cardiac arrest among fire fighters, the NFPA developed guidelines entitled "*Standard on Comprehensive Occupational Medical Program for Fire Departments*," otherwise known as NFPA 1582 [NFPA 2007a]. NFPA recommends annual medical evaluations, including an EKG. Prior to the Captain's death, annual medical evaluations were not required. Had an EKG been conducted as part of a Fire Department annual medical evaluation, perhaps the Captain's left ventricular hypertrophy would have been detected by EKG. This may have led to further medical evaluation and treatment.



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

In addition to screening for risk factors for CAD, NFPA 1582 recommends conducting exercise stress tests on members over the age of 45 with two or more CAD risk factors (hypercholesterolemia, hypertension, smoking, diabetes mellitus, or family history of premature CAD) [NFPA 2007a]. These recommendations are similar to those of the American College of Cardiology (ACC)/American Heart Association (AHA) [Gibbons et al. 2002]. The Captain had two risk factors for CAD (hypercholesterolemia and hypertension), therefore an exercise stress test would have been indicated. Currently, the Fire Department only requires exercise stress tests for members age 55 and older, therefore, the Captain never had an exercise stress test. Had an exercise stress test been performed as part of a Fire Department annual medical evaluation, perhaps his underlying CAD would have been detected, leading to further medical evaluation and treatment.

RECOMMENDATIONS

The NIOSH investigator offers the following recommendations to address general safety and health issues. Had these recommendations been in place prior to 2007, perhaps the Captain's sudden cardiac death could have been prevented.

Recommendation #1: Provide mandatory annual medical evaluations to fire fighters consistent with National Fire Protection Association (NFPA) 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

Guidance regarding the content and frequency of these evaluations can be found in NFPA 1582 and in the IAFF/IAFC *Fire Service Joint Labor*

Management Wellness/Fitness Initiative [NFPA 2007a; IAFF, IAFC 2000]. 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.

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 male fire fighters over the age of 45 with two or more CAD risk factors [NFPA 2007a; Gibbons et al. 2002; IAFF, IAFC 2000]. 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.

Recommendation 3: Provide fire fighters with medical clearance to wear self-contained breathing apparatus (SCBA) as part of the Fire Department's medical evaluation program.

The Occupational Safety and Health Administration (OSHA)'s *Revised Respiratory Protection Standard* requires employers to



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

provide medical evaluations and clearance for employees using respiratory protection [29 CFR¹ 1910.134]. These clearance evaluations are required for private industry employees and public employees in States operating OSHA-approved State plans. Texas does not operate an OSHA-approved State plan; therefore, public sector employers are not required to comply with OSHA standards. The Fire Department has implemented this recommendation with their 2007 annual medical evaluation.

Recommendation 4: Phase-in a comprehensive wellness and fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.

We applaud the Fire Department for starting a mandatory wellness/fitness program consistent with NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Fighters*, and the IAFF/IAFC *Fire Service Joint Labor Management Wellness/Fitness Initiative* [NFPA 2000; IAFF, IAFC 2000]. Worksite health promotion programs have been shown to be cost effective by increasing productivity, reducing absenteeism, reducing the number of work-related injuries, and reducing the number of work-related lost work days [Maniscalco et al. 1999; Stein et al. 2000; Aldana 2001; Stevens et al. 2002; IOM 2003, 2005]. Fire service health promotion programs have been shown to reduce coronary artery disease risk factors and improve fitness levels, with mandatory programs showing the most benefit [Blevins et al. 2006; Dempsey et al. 2002; Womack et al. 2005; Garfi et al. 1996; Harger et al. 1999]. One mandatory program was able to show a cost savings of \$68,741 due to reduced absenteeism [Stein 2002]. 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 [City Auditor1997].

Recommendation 5: Perform an annual physical performance (physical ability) evaluation to ensure fire fighters are capable of performing the essential job tasks of structural firefighting.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* [NFPA 2007b] requires Fire Department members who engage in emergency operations to be evaluated and certified annually by the Fire Department as meeting the physical performance requirements identified in paragraph 8–2.1 of the standard. The Fire Department implemented annual physical performance evaluations in 2007.

Recommendation #6: Eliminate or reduce the frequency of periodic chest x-rays in asymptomatic fire fighters, unless clinically indicated.

According to NFPA 1582, “chest x-rays shall include an initial baseline and shall be repeated every 5 years or as medically indicated” [NFPA 2007a]. Chest x-rays are currently being conducted every other year during the FD’s annual medical evaluation. Conducting chest x-rays this frequently exposes members to unnecessary radiation and represents an unnecessary expense for the FD. In addition, these x-rays are not recommended by the OSHA Hazmat Standard, unless clinically indicated (e.g., respiratory symptoms) [CFR¹ 2002; NIOSH 1985].

¹Code of Federal Regulations. See CFR in references.



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

REFERENCES

- AHA [1998]. AHA scientific position, risk factors for coronary artery disease. Dallas, TX: American Heart Association.
- AHA [2006]. Blood tests for rapid detection of heart attacks. Dallas, TX: American Heart Association. [<http://www.americanheart.org/presenter.jhtml?identifier=4477>]. Date accessed: July 2006.
- Aldana SG [2001]. Financial impact of health promotion programs: a comprehensive review of the literature. *Am J Health Promot* 15:296-320.
- Armstrong WF, Feigenbaum H [2001]. Echocardiography. In: Braunwald E, Zipes DP, Libby P, eds. *Heart disease: a text of cardiovascular medicine*. 6th ed. Vol. 1. Philadelphia, PA: W.B. Saunders Company, p. 167.
- Bigger JT Jr. [1994]. Role of left ventricular ejection fraction. In: Akhtar M, Myerburg RJ, and Ruskin JN, eds. *Sudden cardiac death*. Philadelphia PA: Williams & Wilkins, p. 191.
- Blevins JS, Bounds R, Armstrong E, Coast JR [2006]. Health and fitness programming for fire fighters: does it produce results? *Med Sci Sports Exerc* 38(5):S454.
- CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
- City Auditor, City of Phoenix, AZ [1997]. Disability retirement program evaluation. January 28, 1997.
- Colucci WS, Braunwald E [1997]. Pathophysiology of heart failure. In: Braunwald, ed. *Heart disease*. 5th ed. Philadelphia, PA: W.B. Saunders Company, p. 401.
- Dempsey WL, Stevens SR, Snell CR [2002]. Changes in physical performance and medical measures following a mandatory firefighter wellness program. *Med Sci Sports Exerc* 34(5):S258.
- Fuster V, Badimon L, Badimon JJ, Chesebro JH [1992]. The pathogenesis of coronary artery disease and the acute coronary syndromes. *N Engl J Med* 326(4):242-250.
- Garfi J, Marcotte J, Drury D, Ritterhaus C, Headley S [1996]. The effects of 16 weeks of cross training on resting blood pressure in firefighter recruits. *Med Science in Sports and Exercise* 28(5): S-1: S-14.
- 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 2002 guideline update for exercise testing: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). [<http://content.onlinejacc.org/cgi/content/short/40/8/1531>].
- Harger NB, Matthews MD, Kirk EP [1999]. Moderate aerobic work and regular resistive exercises improve selected fitness components in professional firefighters. *Med Science in Sports and Exercise* 31(5): S-1: S-376.



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

- IAFF, IAFC [2000]. The fire service joint labor management wellness/fitness initiative. Washington, DC: International Association of Fire Fighters, International Association of Fire Chiefs.
- JNC-7 [2003]. National High Blood Pressure Education Program. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; Hypertension 42:1206-1252.
- Jackson E, Skerrett PJ, 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 ed. Philadelphia, PA: Lippincott Williams and Wilkins.
- Libby P [2005]. The pathogenesis of atherosclerosis. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, eds. Harrison's principles of internal medicine. 16th ed. New York: McGraw-Hill, pp. 1425-1430.
- 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.
- Meyerburg RJ, Castellanos A [2005]. Cardiovascular collapse, cardiac arrest, and sudden cardiac death. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, eds. Harrison's principles of internal medicine. 16th ed. New York: McGraw-Hill, pp. 1618-1624.
- NFPA [2007a]. Standard on comprehensive occupational medical program for fire departments. Quincy, MA: National Fire Protection Association. NFPA 1582.
- NFPA [2007b]. Standard on fire department occupational safety and health programs. Quincy, MA: National Fire Protection Association. NFPA 1500.
- NFPA [2000]. Standard on Health-Related Fitness Programs for Fire Fighters. Quincy, MA: National Fire Protection Association. NFPA 1583.
- NIOSH [1985]. Occupational safety and health guidance manual for hazardous waste site activities. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 85-115. [<http://www.cdc.gov/niosh/85-115.html>]. Date accessed: September 2006.
- National Heart Lung and Blood Institute [2005]. Obesity education initiative. [<http://www.nhlbisupport.com/bmi/bmicalc.htm>]. Date accessed: August 2007.
- Shah PK [1997]. Plaque disruption and coronary thrombosis: new insight into pathogenesis and prevention. Clin Cardiol 20 (11 Suppl2):II-38-44.
- Siegel RJ [1997a]. Myocardial hypertrophy. In: Bloom S, ed. Diagnostic criteria for cardiovascular pathology acquired diseases. Philadelphia, PA: Lippincott-Raven, pp. 55-57.



Captain Suffers Sudden Cardiac Death While In Travel Status for Training - Texas

Siegel RJ [1997b]. Cardiomegaly. In: Bloom S, ed. Diagnostic criteria for cardiovascular pathology acquired diseases. Philadelphia, PA: Lippencott-Raven, p. 12.

Siegel RJ [1997c]. Cardiac dilation. In: Bloom S, ed. Diagnostic criteria for cardiovascular pathology acquired diseases. Philadelphia, PA: Lippencott-Raven, pp. 11-12.

Stein AD, Shakour SK, Zuidema RA [2000]. Financial incentives, participation in employer sponsored health promotion, and changes in employee health and productivity: HealthPlus Health Quotient Program. J Occup Environ Med 42:1148-1155.

Stevens SR, Dempsey WL, Snell CR [2002]. The reduction of occupational absenteeism following two years of firefighter wellness program. Med Sci Sports Exerc 34(5):S194.

Thaulow E, Erikssen J, Sandvik L, Erikssen G, Jorgensen L, Cohn PF [1993]. Initial clinical presentation of cardiac disease in asymptomatic men with silent myocardial ischemia and angiographically documented coronary artery disease (The Oslo Ischemia Study). Am J Cardiol 72:629-633.

Womack JW, Humbarger CD, Green JS, Crouse SF [2005]. Coronary artery disease risk factors in firefighters: effectiveness of a one-year voluntary health and wellness program. Med Sci Sports Exerc 37(5):S385.

INVESTIGATOR INFORMATION

This investigation was conducted by and the report written by:

Tommy N. Baldwin, MS
Safety and Occupational Health Specialist

Mr. Baldwin, a National Association of Fire Investigators (NAFI) Certified Fire and Explosion Investigator, an International Fire Service Accreditation Congress (IFSAC) Certified Fire Officer I, a Kentucky Certified Fire Fighter and Emergency Medical Technician (EMT), and a former Fire Chief, is with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio.