1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

47-Year-Old Captain Suffers Fatal Heart Attack at Fire Station – California

Executive Summary

On July 14, 2022, a 47-year-old Captain (CAPT) suffered a fatal heart attack while sleeping at the fire station on the last day of a 72-hour shift. Earlier that day at 0717 hours, the fire station crew was dispatched to a medical aid call. When the CAPT did not show up at the engine for the call, the engineer knocked on his door. When the CAPT did not answer, the engineer opened his bedroom door and found the CAPT in his bed showing obvious signs of death. No medical interventions were initiated.

The medical examiner's report determined the CAPT had atherosclerotic heart disease (ASCVD). There was severe coronary atherosclerosis with near total occlusion of the left anterior descending artery. Other significant conditions included mild aortic atherosclerosis and mild cerebral atherosclerosis. The medical examiner listed cause of death as ASCVD.

Key Recommendations

NIOSH investigators offer the following recommendations to reduce the risk of heart attacks and sudden cardiac arrest among firefighters at this and other fire departments across the country.

- *Key Recommendation #1: Implement comprehensive annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which should include a baseline EKG in all individuals prior to engagement in any strenuous physical activity to rule out any underlying cardiac abnormalities [NFPA 2022].*
- *Key Recommendation #2: Implement an annual fitness evaluation consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure personnel are physically fit to perform job expectations at emergencies [NFPA 2022].*
- *Key Recommendation #3: Employers and employees should be aware of the early warning symptoms of heart attack that could result in SCD.*

The National Institute for Occupational Safety and Health (NIOSH) initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim.

For further information, visit the program Web site at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).

1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

47-Year-Old Captain Suffers Fatal Heart Attack at Fire Station – California

Introduction

On July 14, 2022, a fire captain (CAPT) suffered a fatal heart attack during his sleep at his assigned fire station. The U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this fatality on July 18, 2022. NIOSH contacted the affected department to gather additional information and initiate the investigation.

A medical officer and a contractor firefighter safety specialist with the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) conducted the investigation. In November 2022, the firefighter safety specialist conducted a series of telephone, email, and in-person interviews to investigate the incident.

During the investigation, the NIOSH investigators interviewed family members and the following agency personnel:

- *Fire Chief*
- *Chief Deputy*
- *Battalion Chief*
- *Firefighter*

The NIOSH investigator reviewed the following documents:

- *Fire Department (FD) incident records*
- *FD hiring requirements and standard operating procedures*
- *Crew statements*
- *FD medical examination policies*
- *FD biennial medical records for CAPT*
- *Autopsy and toxicology reports*

Fire Department

At the time of the NIOSH investigation, this career FD conducted both structural and wildland firefighting responses and consisted of 47 fire stations with 58 engines, 6 ladder trucks, 54 wildland patrols, and 521 uniformed personnel. The FD serves a population of approximately

500,000 citizens in a geographic area of about 8,000 square miles and responds to approximately 62,000 calls annually.

Employment and Training

The employment selection process is open to individuals at least 18 years of age. New employees must have a U.S. high school diploma or an equivalency certificate (e.g., G.E.D. or equivalent from a U.S. institution) and a valid California Driver's License at time of appointment. Captains must have two years minimum experience as a firefighter and two additional years of experience as an engineer within the department to be eligible for promotion to captain.

The CAPT had been with the department since April 2002, working as a firefighter and engineer. He worked at the rank of captain since November 2008.

Preplacement/Periodic/Return to Work Medical Evaluations

Preplacement Physical Examination: Per FD policy a medical examination by the County Physician is required for all applicants and includes spine and chest x-rays; blood tests, and urine drug screening. A resting electrocardiogram (EKG) is required starting at age 40 and those who are considered at intermediate risk or higher as per the American College of Cardiology /American Heart Association (ACC/AHA) 10-year Heart Risk Calculator are advised to obtain an exercise stress test [NFPA 2022]. All fire members must meet a minimum fitness level of 10 metabolic equivalents (METs) on a cardiac treadmill stress test, also known as an exercise stress test (EST), without showing signs of myocardial ischemia to actively work in the field. Weight must be proportionate to height and age, and the applicant must meet county physical fitness requirements.

Periodic Medical Examination: Per FD policy, thorough medical examinations ("physicals") are required annually of all employees over age 50 and every other year for those under 50 years of age. The exam includes a fitness assessment, also known as a work capacity test, that may be done on either a treadmill or stationary bicycle and results expressed in METs.

Minimum Fitness Level Standard: The medical examination is the only process to determine an employee's minimum fitness level. Members who fail to obtain 10 METs on the regularly scheduled medical examination will require additional medical consultation. Members assigned to rural stations in the wildland are required to meet 12 METs as outlined in the National Fire Protection Association (NFPA) 1582 and the state mutual aid guidelines under the California Incident Command Certification System [CICCS 2022]. The stress test results are reviewed by a contract physician and the employee is notified in writing of their results, including clearance to work. At the direction of the physician, the member will be provided an improvement plan in an attempt to obtain the desired fitness level. The CAPT obtained a fitness level of 12.4 METs in his last physical evaluation in November of 2020. He was scheduled for his next biennial physical in November of 2022.

Return to Work: Members who have been off-duty or assigned to temporary light duty because of an injury or illness in excess of 60 calendar days, are required to consult with the Administrative Duty Chief prior to returning to active duty. A fit for duty medical evaluation may be required.

Wellness/Fitness Programs

The FD has a wellness/fitness program for all members and encourages participation. It is the company officer or immediate supervisor's responsibility to make a reasonable effort to allocate sixty minutes of physical fitness each on-duty day. Sufficient fitness equipment is provided at each fire station. The FD does not mandate that firefighters participate in the fitness program at work, but they must meet the physical fitness requirements. Some members utilize local gyms to conduct their physical fitness program. The CAPT participated in some physical training and weightlifting at the station, but he was inconsistent.

Investigation

On July 11, 2022, at approximately 0800 in the morning, the CAPT arrived for work at his station for his regularly scheduled 48-hour shift. The station serves a small rural community. It is a single engine station staffed by a captain, engineer, and a firefighter. During the first day of his shift, the CAPT and his crew responded to two outside rubbish fires and a building fire. There was nothing remarkable about either of these incidents. There were no responses on the second day of his 48-hour shift.

On July 13th the CAPT worked an overtime shift at his normally assigned station. At approximately 0400 hours that morning, the CAPT and crew responded to a structure fire but were placed on standby and did not actively suppress the fire. At approximately 0830 the CAPT told the Firefighter he was tired, but the Firefighter assumed it was due to the early morning call. At approximately 1700 hours, the shift Battalion Chief stopped by the station on his rounds and spoke to the CAPT as he was doing a light workout in the engine bay. The Battalion Chief said the CAPT did not appear to be sweaty and did not voice any complaints about how he was feeling. The Engineer spoke with the CAPT around 1830 hours as they cooked dinner, and at that time he appeared to be feeling fine. At approximately 2100 hours that night, the Firefighter went to the kitchen to get water and spoke to the CAPT briefly. The Firefighter noticed that the CAPT was extremely sweaty but did not express any complaints.

The crew was dispatched to a medical aid call at 0717 on July 14, 2022. When the CAPT failed to emerge from his sleeping quarters, the Engineer went to his room and knocked on the door. When he did not answer, the Engineer entered the room and found the CAPT laying supine in his bed and unresponsive. No medical intervention was initiated because he had no pulse and was cold to the touch. The crew advised dispatch that they were unable to respond to the medical aid call, and then they notified the Battalion Chief by landline.

Medical Findings

The medical examiner's report determined the CAPT had atherosclerotic cardiovascular disease (ASCVD). There was severe coronary atherosclerosis with near total occlusion of the left anterior descending artery. Other significant conditions included mild aortic atherosclerosis, mild cerebral atherosclerosis, and obesity with a body mass index (BMI) of 37.6. The toxicology report was negative.

Cause of Death

The medical examiner listed cause of death as atherosclerotic heart disease.

Discussion

Sudden Cardiac Events

Sudden cardiac arrest (SCA) is when the heart suddenly fails to pump blood. If the individual does not survive, the term sudden cardiac death (SCD) is used. These events mostly occur in patients with structural heart disease (that may not have been previously diagnosed), particularly coronary heart disease (CHD).

SCD accounts for 300,000–400,000 deaths annually in the United States. Most sudden deaths are cardiac, and most SCDs are related to arrhythmias secondary to structural heart disease or primary electrical abnormalities of the heart [Isbister and Semsarian 2019; Jazayeri and Emert 2019; Kuriachan et al. 2015]. SCA usually occurs in people with some form of underlying structural heart disease, and as much as 70 percent of SCAs have been attributed to CHD. The risk of experiencing SCA increases dramatically with age and with underlying cardiac disease. Men are two to three times more likely to experience SCA than women. SCD is the mechanism of death in over 60 percent of patients with known CHD. In addition, SCA is the initial clinical manifestation of CHD in approximately 15 percent. Even among the young, CHD is a relatively common cause of SCD. In one study, CHD was the second most common condition (22%) underlying SCD among subjects aged 5 to 34 years. In this study, the most common SCA-related conditions were sudden arrhythmic death syndrome (31%), coronary artery disease (22%), and hypertrophic cardiomyopathy (14%). There was a high overall prevalence of established cardiovascular risk factors (obesity, diabetes mellitus, hypertension, elevated blood cholesterol, smoking) with ≥1 risk factor present in 58% of persons with SCA [Jayaraman et al. 2018].

Risk factors for SCA include elevated blood cholesterol, hypertension, cigarette smoking, physical inactivity, obesity, diabetes mellitus, and a family history of premature CHD or myocardial infarction. There is also some evidence that acutely stressful situations increase the risk of SCA. Individuals of African American descent appear to have a higher rate of SCD and poorer outcomes compared to those of Caucasian or Hispanic descent [Wong et al. 2019].

Prevention of SCA and SCD is focused on identifying underlying risk factors. Some risk factors are modifiable such as reducing cholesterol and blood pressure, quitting smoking, increasing physical activity, losing weight, and controlling diabetes. Other risk factors are not modifiable such as age or family history of CAD. Several risk factors can be used to calculate a risk score for CHD (Table 1); these factors include BMI, blood pressure, serum lipids and glucose. Based on age and other risk factors, the ACC/AHA atherosclerotic cardiovascular disease (ASCVD) risk calculator can estimate the percent 10-year risk of heart attack or stroke [Andrus and Lacaille 2013].

47-Year-Old Captain Suffers Fatal Heart Attack at Fire Station – California

Table 1. Cardiovascular disease risk factors and associated category of risk

Risk Factor	Interpretation	Category Guidelines
Systolic BP*	Normal Elevated Stage 1 Hypertension Stage 2 Hypertension	< 120 mmHg 120–129 mmHg 130–139 mmHg ≥ 140 mmHg
Diastolic BP*	Normal Elevated Stage 1 Hypertension Stage 2 Hypertension	< 80 mmHg > 80 mmHg 80–89 mmHg ≥ 90 mmHg
Total Cholesterol†	Desirable Borderline high High	< 200 mg/dL 200–239 mg/dL ≥ 240 mg/dL
HDL†	Low High (Desirable)	< 40 mg/dL ≥ 60 mg/dL
LDL†	Optimal Above normal Borderline high High	< 100 mg/dL 100–129 mg/dL 130–159 mg/dL > 160 mg/dL
Triglycerides‡	Normal Hypertriglyceridemia Severe hypertriglyceridemia	> 175 mg/dL 175–499 mg/dL ≥ 500 mg/dL
Blood Glucose§	Normal Prediabetes Diabetes	< 100 mg/dL 100–125 mg/dL ≥ 126 mg/dL
BMI¶	Underweight Normal weight Overweight Obesity	< 18.5 kg/m^2 18.5–24.9 kg/m^2 25–29.9 kg/m^2 ≥ 30 kg/m^2

*Whelton et al. 2018, †Kratz et al. 2004, ‡Grundy et al. 2019, §ADA 2014, ¶CDC 2022a

The CAPT in this case was obese and based on his 2020 medical examination results his ASCVD 10-year risk was considered low at 4.2%.

The presence of severe coronary atherosclerosis with near total occlusion of the left anterior descending artery on autopsy suggests that the atherosclerotic plaques in the CAPT's coronary arteries had been building up over several years. The Duke Treadmill Score is a point system to predict 5-year mortality based on treadmill ECG stress testing in patients without known coronary artery disease [Shaw et al. 1998]. A Low risk (score > 5) indicates a 5-year survival of 97%; an Intermediate risk (score between 4 and -11) indicates 5-year survival of 90%; and a High risk (score < -11) indicates 5-year survival of 65%. The CAPT had a Duke Treadmill Score in 2020 of -20, but on review of the EKG tracing with a cardiac specialist, it was determined that this was likely due to an artifact (possible loose EKG lead).

In most cases, an EST can identify the presence of CHD that increases the risk of fatal and non-fatal cardiac events. An abnormal EKG that shows myocardial ischemia (areas of the heart where the blood supply is not adequate) with exercise increases the risk of future CHD events, especially in those individuals with other risk factors for heart disease such as high blood pressure, high lipid levels, elevated blood sugar or obesity [Balady et al. 2004; Bruce et al. 1980; Mégnien and Simon 2009; Michaelides et al. 1990; Michaelides et al. 1995; Michaelides et al. 2005; Sumanen et al. 2005; Van Campen et al. 1996]. As recommended by NFPA 1582, the EST in general is one of the best ways to assess cardiovascular disease and the ability to engage in activities that place a high demand on the heart.

In this case, the CAPT had severe coronary atherosclerosis with near total occlusion of the left anterior descending artery, but his EST did not show that he had ischemia and so was not predictive of the CAPT's sudden cardiac death. A meta-analysis of 34 studies of EST and coronary artery disease found that although a positive EST is often accurate at confirming the presence of significant blockages of the coronary arteries, "a negative exercise test result is not as good at excluding CAD and the clinical challenge of knowing which of these test-negative patients benefit from urgent coronary angiography and treatment remains" [Banerjee et al. 2012]. Therefore, it is important for patients to understand that a negative EST (or the ability to achieve high METS on the EST without signs or symptoms of ischemia) does not guarantee clear coronary arteries so any potential heart attack signs or symptoms should still be taken seriously.

In this incident, the Firefighter had noticed that the CAPT was extremely sweaty. Sweating is among the symptoms of a heart attack that could result in SCD. Other heart attack symptoms may also include chest pain/discomfort, shortness of breath, lightheadedness, and pain/discomfort in the jaw, neck, back, arms or shoulders [American Heart Association 2021; CDC 2022b].

Recommendations

Recommendation #1: Implement comprehensive annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which includes a cardiac exercise stress test for all individuals prior to engagement in any strenuous physical activity to rule out any underlying cardiac anomalies [NFPA 2022].

Discussion: NIOSH recommends that all new and incumbent personnel participate in annual medical evaluations to determine that members are healthy enough to participate in strenuous activity and to identify potential injuries or illnesses. Guidance regarding the content and frequency of the medical evaluations for firefighters can be found in Chapter 7 of NFPA 1582. At the time of the incident, the department required biennial medical examination for members under 50 years of age, and annual exams for members 50 years of age and over [NFPA 2022].

Recommendation #2: Implement an annual fitness evaluation consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure personnel are physically fit to perform job expectations at emergencies [NFPA 2022].

Discussion: NIOSH recommends that fire departments phase in an annual fitness evaluation program that is consistent with *NFPA 1582-Chapter 8-Annual Occupational Fitness Evaluation of Members* to ensure personnel can meet state and job requirements, NFPA 1582 [NFPA 2022]. The department

medical exams do include a stress EKG to determine capacity for physical exertion and decrease the risk of sudden cardiac death. The stress EKG required all members to meet a minimum level of 10 MET's. In addition, members assigned to wildland fire response and the state mutual aid system must meet a minimum of 12 METs, or successfully complete the Wildland Firefighting Work Capacity Test (Pack Test) annually. The California Incident Command Certification System [CICCS 2022] requires all fire departments in California that participate in statewide mutual aid to certify their members meet the "arduous" fitness level requirement as defined in the National Wildland Coordinating Group (NWCG) fitness requirements [NWCG Fitness and Work Capacity 2009]. NIOSH recommends all firefighters assigned to arduous work be capable of meeting a minimum of 12 METs annually, as outlined in NFPA 1582-Chapter 8 [NFPA 2022].

An exercise stress test can detect areas of the heart that show ischemia only during exertion; the presence of these areas increases the risk of fatal and non-fatal cardiac events. If the stress EKG indicates ischemia, the individual should be referred to a heart specialist for additional evaluation to determine if there may be an increased risk for SCA and SCD while performing firefighter job tasks. However, it is important to keep in mind that a negative EST does not rule out the presence of underlying blockages in the coronary arteries so any signs or symptoms consistent with a heart attack even in someone who had a negative EST should prompt immediate medical evaluation.

Recommendation #3: Employers and employees should be aware of the early warning symptoms of a heart attack that could result in SCD.

If you or someone you work with experience symptoms that could be a heart attack, immediate medical attention can save lives by making a prompt diagnosis and starting life-saving interventions. If you see possible heart attack symptoms in someone else or hear them report symptoms consistent with a heart attack, encourage them to do the same.

References

American Diabetes Association (ADA) [no date]. Diabetes overview: prediabetes. Arlington, VA. Date accessed: November 2023.

American Heart Association (AHA) [2021]. Warning signs of a heart attack. Dallas, TX: American Heart Association.

Andrus B, Lacaille D [2014]. 2013 ACC/AHA guideline on the assessment of cardiovascular risk. J Am Coll Cardiol *63*(25 Pt A):2886.

Balady GJ, Larson MG, Vasan RS, Leip EP, O'Donnell CJ, Levy D [2004]. Usefulness of exercise testing in the prediction of coronary disease risk among asymptomatic persons as a function of the Framingham risk score. Circulation *110*(14):1920–1925.

Banerjee A, Newman DR, Van den Bruel A, Heneghan C [2012]. Diagnostic accuracy of exercise stress testing for coronary artery disease: a systematic review and meta-analysis of prospective studies. Int J Clin Pract *66*(5):477–492.

Bruce RA, DeRouen TA, Hossack KF, Blake B, Hofer V [1980]. Value of maximal exercise tests in risk assessment of primary coronary heart disease events in healthy men: five years' experience of the Seattle heart watch study. Am J Cardiol *46*(3):371–378.

CICCS [2022]. California incident command certification system 2022 qualifications guide.

Centers for Disease Control and Prevention (CDC) [2022a]. About adult BMI.

Centers for Disease Control and Prevention (CDC) [2022b]. Heart attack symptoms, risk, and recovery.

Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, Braun LT, de Ferranti S, Faiella-Tommasino J, Forman DE, Goldberg R, Heidenreich PA, Hlatky MA, Jones DW, Lloyd-Jones D, Lopez-Pajares N, Ndumele CE, Orringer CE, Peralta CA, Saseen JJ, Smith SC Jr, Sperling L, Virani SS, Yeboah J [2019]. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA guideline on the management of blood cholesterol: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on clinical practice guidelines. J Am Coll Cardiol *73*(24):3168–3209.

Isbister J, Semsarian C [2019]. Sudden cardiac death: an update. Intern Med J *49*(7):826–833.

Jayaraman R, Reinier K, Nair S, Aro AL, Uy-Evanado A, Rusinaru C, Stecker EC, Gunson K, Jui J, Chugh SS [2018]. Risk factors of sudden cardiac death in the young: multiple-year community-wide assessment. Circulation *137*(15):1561–1570.

Jazayeri MA, Emert MP [2019]. Sudden cardiac death: who is at risk? Med Clin North Am *103*(5):913–930.

Kratz A, Ferraro M, Sluss PM, Lewandrowski KB [2004]. Case records of the Massachusetts General Hospital. Weekly clinicopathological exercises. Laboratory reference values. N Engl J Med *351*(15):1548–1563.

Kuriachan VP, Sumner GL, Mitchell LB [2015]. Sudden cardiac death. Curr Probl Cardiol *40*(4):133–200.

Mégnien JL, Simon A [2009]. Exercise tolerance test for predicting coronary heart disease in asymptomatic individuals: a review. Atherosclerosis *205*(2):579–583.

Michaelides AP, Triposkiadis FK, Boudoulas H, Spanos AM, Papadopoulos PD, Kourouklis KV, Toutouzas PK [1990]. New coronary artery disease index based on exercise-induced QRS changes. Am Heart J *120*(2):292–302.

Michaelides A, Ryan JM, Bacon JP, Pozderac R, Toutouzas P, Boudoulas H [1995]. Exercise-induced QRS changes (Athens QRS score) in patients with coronary artery disease: a marker of myocardial ischemia. J Cardiol *26*(5):263–272.

Michaelides AP, Aigyprladou MN, Andrikopoulos GK, Richter DJ, Kartalis A, Tapanlis E, Fourlas CA, Stefanadis CI [2005]. The prognostic value of a QRS score during exercise testing. Clin Cardiol *28*(8):375–380.

NFPA [2022]. NFPA 1582. Standard on comprehensive occupational medical program for fire departments. Quincy, MA: National Fire Protection Association.

NWCG [2009]. Fitness and work capacity, PMS 304-2. National Wildfire Coordinating Group.

Shaw LJ, Peterson ED, Shaw LK, Kesler KL, DeLong ER, Harrell FE Jr, Muhlbaier LH, Mark DB [1998]. Use of a prognostic treadmill score in identifying diagnostic coronary disease subgroups. Circulation *98*(16):1622–1630.

Sumanen M, Jussila M, Mattila K [2005]. Exercise treadmill test may predict clinical outcome among working-aged patients suspected of coronary heart disease in general practice. Scand J Prim Health Care *23*(1):47–51.

van Campen CM, Visser FC, Visser CA [1996]. The QRS score: a promising new exercise score for detecting coronary artery disease based on exercise-induced changes of Q-, R- and S-waves: a relationship with myocardial ischaemia. Eur Heart J *17*(5):699–708.

Whelton PK, Carey RM, Aronow WS, Casey Jr DE, Collins KJ, Himmelfarb CD, DePalma SM, Samuel Gidding, Jamerson KA, Jones DW, MacLaughlin EJ, Muntner P, Ovbiagele B, Smith Jr SC, Spencer CC, Stafford RS, Taler SJ, Thomas RJ, Williams Sr KA, Williamson JD, Wright Jr JT [2018]. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol *71*(19):e127–e248.

Wong CX, Brown A, Lau DH, Chugh SS, Albert CM, Kalman JM, Sanders P [2019]. Epidemiology of sudden cardiac death: global and regional perspectives. Heart Lung Circ *28*(1):6–14.

Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiac/Medical Team, in Cincinnati, Ohio. Co-author TJ Welch is a Firefighter Safety Specialist that has worked in volunteer, industrial and municipal fire departments. Mr. Welch is a State Certified Fire Officer, founding member of the California Incident Command Certification System, and chaired the CICCS committee on Physical Fitness Standards. Dr. Robert Harrison MD, MPH (California Department of Public Health) provided medical consultation, and Laura Styles, MPH (Public Health Institute) also contributed to this report.

Disclaimer

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH). In addition, citations to Web sites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these Web sites.