

LINE OF DUTY DEATH REPORT

F2023-01 • April 2024

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32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

Executive Summary

On May 30, 2022, a 32-year-old male firefighter (Driver) suffered a fatal heart attack during his sleep at the fire station. On May 31, 2022, the father of the Driver drove to the volunteer fire station after multiple text messages to his son went unanswered. The father arrived at the station and met with the captain on duty. Both the captain and father went to the Driver's room and found him unresponsive laying supine in his bed and showing obvious signs of death. No medical intervention was initiated. The Captain made appropriate notifications to the local emergency medical service (EMS) agency, the Fire Chief (FC) and sheriff's office.

The medical examiner's report listed the cause of death as ischemic heart disease with coronary artery thrombus.

The Driver had been a member of the fire department (FD) for 12.5 years. He was state certified in FFI/FFII, Hazardous Materials Operations, Emergency Vehicle Driver, Driver Operator-pumps, and Emergency Medical Care. He was a Driver/Operator (Driver) for the department, operated all FD vehicles and responded to all calls when available. The Driver was awarded the Firefighter of the Year award several times during his tenure with the department.

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 pre-placement and annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which includes heart risk calculators to identify early risk of heart disease [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. The fitness evaluation should include stress EKG to assist in identifying ischemia [NFPA 2022].*
- *Key Recommendation #3: Implement training on heart attack signs and symptoms, offer periodic refresher training on this issue, and encourage those who experience any of these to seek immediate medical evaluation.*

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

- *Key Recommendation #4: Ensure that individuals with Graves' disease and/or Hashimoto's thyroiditis receive an appropriate evaluation for these conditions as part of their initial and annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments [NFPA 2022].*

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).



32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

Introduction

On May 30, 2022, a firefighter (Driver) suffered a fatal heart attack while asleep and was found deceased in his bed at his assigned fire station. The coroner listed the cause of death as ischemic heart disease with coronary artery thrombus. 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 initiated 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 March 2023, 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*
- *Fire Captain*
- *Parents of the Driver*

The NIOSH investigator reviewed the following documents:

- *FD incident records*
- *Crew statements*
- *Autopsy and toxicology reports*
- *Sheriff's report*

Fire Department

At the time of the NIOSH investigation, the volunteer fire department (FD) consisted of two fire stations with three engines, two water tankers, one brush truck, and one Quick Response Vehicle (QRV). The FD had 65 members, that included a fire chief, two assistant chiefs, 40 state certified firefighters, 8 paid staff firefighters, and 17 support personnel. Four of the firefighters were considered resident firefighters that lived permanently at Fire Station 2. Resident firefighters are responsible for station maintenance, equipment maintenance, and responding to calls.

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

The FD responds to approximately 500 calls annually serving a population of approximately 7,000 citizens in a geographic area of about 46 square miles with rural, residential housing and two highways.

Employment and Training

The selection process for volunteer firefighters includes:

- Submit a completed application:
 - a. Those 14–18 years old must complete an application for junior firefighter.
 - b. Those older than 18 years of age must complete an application for volunteer firefighter.
- Background checks are performed for all applicants.
- An interview conducted by the FD's personnel committee, which then makes a recommendation to the Fire Chief.

The FD provides weekly training on Monday evenings and requires all firefighters to attend a minimum of 36 hours training time annually to remain active. To receive certification, firefighters must successfully complete 240 hours of FF1/FF2 state certified training. In addition, emergency medical technicians (EMTs) must complete 12 hours of emergency medical services (EMS) training. Drivers must complete 12 hours of state certified driver training and all members must respond to a minimum of one call per quarter.

Preplacement/Periodic/Return to Work Medical Evaluations

The FD does not currently have pre-placement or periodic medical evaluations. Return to work evaluations are completed by the firefighter's personal physician.

Wellness/Fitness Programs

The FD encourages physical fitness and has gym equipment at fire station 2. However, the FD does not offer a comprehensive wellness/fitness program as recommended by the International Association of Firefighters/International Association of Fire Chiefs Wellness Fitness Initiative [IAFF/IAFC 2018].

Investigation

The Driver was 1 of 8 full-time staff members that lived full-time at fire station 2. As a resident firefighter, he had his own bedroom and bathroom.

On May 30, 2022, the Driver was last seen by the fire station video camera at approximately 0900 hours going to his room. Earlier that morning, the Driver assisted the Fire Chief (FC) in hooking up his boat as they had planned to spend Memorial Day weekend at the lake. After assisting the FC with the boat, he told the chief he would see him out at the lake a little later that day.

The FC called the Driver at 0953 to see when he was going to make it to the lake. The Driver told him he was not feeling well and was going to lay down for a while. The FC asked him what was wrong and if he needed anything. The Driver replied saying that he was having cold sweats and was nauseated but declined any help. The FC then asked if he thought he might have COVID-19 or the flu, but the Driver

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

said he didn't think so. He reported feeling that he thought he would feel better if he could just vomit. Immediately following the conversation with the FC, the Driver texted his father stating that he was not going to the lake with the FC but did not go into detail about not feeling well.

One of the other resident firefighters had spent the night of May 30th at the station and been in and out of the station the following morning. During that time, he never saw the Driver, but he did notice the Driver's personal truck had been parked in the same place all day with the window down. On the morning of May 31st, the Captain reported to work at 0800 hours. He was bringing his gear in the station and getting ready for the day when the Driver's father arrived. The father came to the station to check on him because he had been texting his son and never received a reply. The Captain led the father to the Driver's bedroom where he was found deceased in his bed. The Captain left the room and allowed the father to have some time with his son while he made notifications. Medical crews arrived and confirmed the Driver was deceased.

Medical Findings

The medical examiner's report identified a 32-year-old man with a medical history significant for Graves' disease and autism, who was found unresponsive in his bed at the FD. Emergency medical personnel responded, and death was pronounced with no resuscitative efforts. It was reported that an older medication vial containing pills of atenolol was found at the scene. The autopsy was significant for an enlarged heart with an area of recent injury consistent with damage from an acute total occlusion of the left main coronary artery from a blood clot. In addition to enlargement, the heart also showed changes consistent with Graves' disease. Examination of the thyroid revealed findings consistent with both Graves' disease and Hashimoto's thyroiditis. Postmortem toxicology screens revealed no evidence of ethanol or drugs.

The Driver was 5'10" and 174 pounds. His body mass index (BMI) was 25, indicating he was borderline overweight [CDC 2022].

Cause of Death

The medical examiner listed cause of death as ischemic heart disease with coronary artery thrombus.

Discussion

Ischemic Heart Disease

Buildup of plaque on coronary arterial walls reducing blood flow and oxygen is the primary cause of ischemic heart disease. The reduction in blood flow may result in partial or complete blockage of heart arteries potentially resulting in death. Ischemic heart disease is synonymous with coronary artery disease (CAD) and according to the Centers for Disease Control and Prevention (CDC), it is the most common type of heart disease and leading cause of heart attack in the United States [CDC 2023a].

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

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

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 [Kuriachan et al. 2015]. 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 and can be changed 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; these factors include BMI, blood pressure, serum lipids and glucose. Based on age and other risk factors, the American College of Cardiology/American Heart Association (ACC/AHA) atherosclerotic cardiovascular disease (ASCVD) risk calculator can estimate the percent 10-year risk of heart attack or stroke [ACC/AHA 2023; Andrus and Lacaille 2014; Lloyd-Jones et al. 2019].

According to the autopsy report, the Driver had a history of Graves' disease. Graves' disease is an autoimmune thyroid disease and a common cause of hyperthyroidism. Thyroid hormones have multiple adverse effect on the cardiovascular system through many direct and indirect mechanisms, including an increase in heart rate, cardiac contractility, systolic and mean pulmonary artery pressure, cardiac output, diastolic relaxation, and myocardial oxygen consumption. If Graves' disease is not treated, these changes in the cardiovascular system can eventually lead to heart failure, arrhythmias, systemic and pulmonary hypertension. Cardiovascular complications of Graves' disease are frequent and important causes of increased morbidity and mortality [Bartalena 2018; Biondi and Kahaly 2010; Gawałko et al. 2020]. Autopsy evaluation of the heart did show some changes that could be consistent with chronic Graves' disease such as the enlargement of the heart with dilation of both right and left ventricles and diffuse fibrosis of the top layer of heart muscle (endocardium) [Tsymbailuk et al. 2015]. Beta blockers such as atenolol are often used to control symptoms such as palpitations, tachycardia,

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

tremulousness, anxiety, and heat intolerance. The Driver was found with a bottle of atenolol pills at the scene, suggesting he may have been receiving treatment for his Graves' disease. As medical records were not available, it is not known when his Graves' disease was diagnosed, if his Graves' disease was under control, or if it may have contributed to his death.

The Driver's thyroid showed features of both Graves' disease and Hashimoto's thyroiditis. The latter is an autoimmune disorder in which the body produces antibodies that attack the thyroid resulting in damage that limits the gland's ability to produce thyroid hormones. Signs and symptoms of low thyroid hormone levels, also known as hypothyroidism, include low blood pressure, weight gain, low energy levels, eyebrow thinning, etc. Although uncommon, there have been cases of patients developing Hashimoto's thyroiditis following treatment of Graves' disease. The mechanism for this is unknown and the time between onset of Graves' disease symptoms, treatment of Graves' disease, and the development of Hashimoto's thyroiditis can vary widely from a few months to 25 years [Oueslati et al. 2022; Umar et al. 2010].

The Driver also had a history of autism. In one recent meta-analysis that examined the association between autism spectrum disorders and cardiometabolic diseases, autism was associated with increased risk of heart disease [Dhanasekara et al. 2023]. The authors concluded that individuals with autism seem to be at a greater associated risk of developing atherosclerotic heart disease by 45.9% and discuss several etiological factors such as genetic variants, medications, toxins, maternal obesity, and maternal diabetes; and prematurity and intrauterine growth retardation that may contribute to obesity and related cardiometabolic disease. The extent to which the Driver's autism may have been a risk factor for his death due to ischemic heart disease is not known.

Recommendations

Recommendation #1: Implement comprehensive pre-placement and annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which includes heart risk calculators to identify early risk of heart disease [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.

NFPA 1582 chapter 7, section 7 Risk Stratification - identifies the need for members 40 years old or known to be at high risk for heart disease to be assessed for coronary heart disease [NFPA 2022]. The examiner should utilize either the 2-year Framingham risk table or the American College of Cardiology/American Heart Association (ACC/AHA) 10-year heart risk calculator to help identify early risk of heart disease. At the time of the incident, the FD did not require medical evaluations for new or incumbent members. The driver suffered from atherosclerotic cardiovascular disease, a condition where the arteries become narrowed and hardened due to buildup of plaque (fats) in the artery wall. When detected, atherosclerotic cardiovascular disease is treatable.

Volunteer firefighters comprise a significant portion of the U.S. Fire Service. As of 2022, the National Volunteer Fire Council (NVFC) estimated that 65% (676,900 out of 1,041,200) of U.S. firefighters were volunteers [NVFC 2022]. The NFPA recognizes that volunteer departments are often working

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

with limited funding and resources compared to paid crews. NFPA 1720 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments provides tailored guidance to volunteer departments [NFPA 2020]. The NVFC/NFPA joint publication “[Understanding and Implementing NFPA Standards 1500, 1720, and 1851](#)” provides practical suggestions on additional resources volunteer departments may utilize to improve their compliance with the NFPA consensus standards. This joint publication suggests that volunteer departments who lack their own fire department physician to conduct initial and/or annual medical evaluations of their members may want to consider reaching out to local hospitals or private practice groups to see if a partnership could be established to conduct these evaluations as “medical professionals may be willing to assist first responders at low or no cost.” And if that is not feasible, consider creating a departmental policy to require members to have their medical evaluations done by their personal physician [NVFC/NFPA 2012]. This would also assist the primary care providers to become familiar with the essential job tasks of their volunteer firefighter patients as often these assessments come with an attestation statement that the provider is certifying that they are familiar with the essential job tasks of firefighting and the individual they are certifying is able to perform these tasks without undue risk to their health [NFPA 2022].

The presence of the atenolol prescription indicated that the Driver had seen a healthcare provider to get it. Atenolol artificially slows the heart rate and can be used to treat heart attacks (reducing heart rate, reduces the oxygen demand of heart muscle that is in distress from decreased or disrupted blood flow that brings oxygen due to blood clots or atherosclerotic plaques restricting blood flow inside the cardiac vessels), prevent future heart attacks in patients who have one before, control abnormal heart rhythms, etc. in addition to controlling symptoms of Graves’ disease [AHA 2024]. It is important for all firefighters to tell their provider about their firefighting activities so the provider is aware of the strenuous tasks and cardiovascular stress the patient may experience as part of their job. Knowledge of such cardiovascular tasks will create closer oversight of the patient’s cardiovascular status, better awareness of increased risk for a cardiac event, and improved patient education that may allow them to recognize symptoms that need an immediate medical evaluation.

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 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 2022].

An exercise stress test can also detect ischemia (areas of the heart where the blood supply is not adequate) that 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 heart disease while performing firefighter job tasks.

32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

Recommendation #3: Implement training on heart attack signs and symptoms, offer periodic refresher training on this issue, and encourage those who experience any of these to seek immediate medical evaluation.

Discussion: This Driver reported to several individuals that he had nausea, general malaise, and cold sweats hours before being found deceased; these signs and symptoms could be consistent with an evolving heart attack [CDC 2024]. Although he was only 32 years of age, it is important to be aware that “heart disease can happen at any age”. Heart attack risk increases with age and having other medical conditions like high blood pressure, high cholesterol, and Graves’ disease [CDC 2023b]. Any individual, regardless of age, reporting possible heart attack signs and/or symptoms should be encouraged to seek immediate medical evaluation.

Recommendation #4: Ensure that individuals with Graves’ disease and/or Hashimoto’s thyroiditis receive an appropriate evaluation for these conditions as part of their initial and annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments [NFPA 2022].

Discussion: NIOSH recommends that fire departments implement initial and annual medical evaluations consistent with Chapter 9 Section 7 of NFPA 1582 that states “*Diseases of the adrenal gland, pituitary gland, parathyroid gland, or thyroid gland.* The individual should be evaluated for absence of orthostatic hypotension, electrolyte disorders, ability to maintain hydration during exercise under extreme environmental conditions, and normal thyroxine levels with supplementation.” The FD was likely unaware of this aspect of the Driver’s medical history since they do not have pre-placement (initial) or periodic (annual) medical evaluations as part of their standing policy. This volunteer FD relies on members’ own primary care providers to conduct return to duty medical evaluations.

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32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

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32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

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Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiac/Medical Team, in Cincinnati, Ohio. TJ Welch is a Firefighter Safety Specialist and worked in volunteer, industrial and municipal fire departments and co-authored the report. 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.

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32-Year-Old Driver Suffers Fatal Heart Attack at Fire Station — North Carolina

Highlights from Investigation F2023-01

The Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) investigated the death of a 32-year-old volunteer firefighter (Driver) that occurred in bed at his fire station. He died from ischemic heart disease with coronary artery thrombus on May 30, 2022.

What We Did

- Interviewed Fire Chief, Fire Captain, and family members about the incident.
- Reviewed volunteer fire department incident records, crew statements, autopsy and toxicology reports, and sheriff's report.

What We Found

- The fire department does not conduct pre-placement or periodic medical evaluations as per NFPA 1582 standard.
- The fire department provides fitness equipment at one station for personnel to use. However, the department does not offer a comprehensive wellness/fitness program.
- The Driver was a resident volunteer firefighter who lived full-time at the fire station. Earlier in the morning, the Driver helped the Fire Chief hook up a boat to his truck. Soon after, he told the Chief he did not feel well and was going to lay down. The next day, the Driver's was found deceased in his bed at the station.
- The Driver's autopsy was significant for an enlarged heart with areas of scarring. He had atherosclerotic cardiovascular disease, a condition where the arteries become narrowed and hardened due to buildup of plaque in the artery wall. When diagnosed, atherosclerotic cardiovascular disease is treatable.
- An autopsy determined the cause of death was ischemic heart disease with coronary artery thrombus.

What Fire Departments and Firefighters Can Do

- Provide educational materials and learn about atherosclerotic cardiovascular disease and possible risk reduction methods as part of physical fitness education.
- As recommended in NFPA 1582, provide and participate in:
 - pre-placement and annual medical evaluations, including a baseline EKG, to evaluate aerobic capacity before participating in strenuous physical activity.
 - annual fitness evaluations to ensure personnel can meet state and job requirements. A cardiac exercise stress test can detect ischemia (areas of the heart where the blood supply is not adequate). If the stress EKG indicates ischemia, the individual should be referred to a heart specialist to determine risk of sudden cardiac arrest.

