1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

58-year-old Driver/Engineer with Diabetes Dies from Heart Attack, Florida

Executive Summary

On the morning of Sunday, June 5, 2022, a 58-year-old driver/engineer (ENG) with a history of diabetes left the fire station to return home after completing a routine 48-hour shift. He did not report feeling unwell to any of the staff at the station that weekend. During the early hours of Monday, June 6, 2022, he began to have chest pain and called 911. An EKG obtained by paramedics during transport was consistent with an acute heart attack. This was relayed to the Emergency Department (ED) staff resulting in their calling a "cath alert" (activating the cardiology staff and alerting those in the cardiac catheterization laboratory to an incoming critical patient). On arrival to the ED, he was being stabilized and prepared for transport to the cardiac catheterization laboratory when he went into cardiac arrest and was unable to be resuscitated.

Key Recommendations

NIOSH offers the following recommendations to reduce the risk of heart attacks and sudden cardiac arrest among firefighters, including those with diabetes, at this and other fire departments across the country.

Key Recommendation #1: Consider requiring annual medical evaluations. Although annual medical evaluations are not required by department policy, NFPA 1582 recommends annual medical evaluations of members [NFPA 2022]. [NFPA 2022].

Key Recommendation #2: Ensure that firefighters with insulin dependent diabetes (type 1 or type 2) meet the provisions set forth in NFPA 1582 to be able to engage in firefighting tasks safely without restriction.

Key Recommendation #3: Phase in a mandatory comprehensive wellness and fitness program for firefighters following guidance from NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters [NFPA 2015]

Key Recommendation #4: Ensure that firefighters undergo cardiovascular disease screening as recommended in NFPA 1582 [NFPA 2022].

Please note that although NFPA standards are updated periodically, it is our practice to cite the version in effect at the time of the fatality. In 2025, the NFPA standards 1581-1584 that we cite in this report were consolidated into a single standard designated as 1580.

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 website at www.cdc.gov/niosh/firefighters/fffipp/about.html or call toll free 1-800-CDC-INFO (1-800-232-4636).

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58-year-old Diabetic Driver/Engineer Dies from Heart Attack, Florida

Introduction

On, June 6, 2022, a driver/engineer (ENG) developed chest pain after returning home from the station following a 48-hour shift. 911 was called and the ENG was taken to the ER with an acute myocardial infarction. He died in the ED before he could be transported to the hospital's cardiac catheterization laboratory. The U.S. Fire Administration announced this fatality through its firefighter fatality email notification service. NIOSH contacted the affected department to gather additional information and initiate the investigation.

A medical officer and a firefighter safety specialist with the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) conducted the investigation. NIOSH staff conducted a site-visit September 11-15, 2022.

During the investigation, NIOSH representatives interviewed the following people:

- Fire department (FD) Chief
- Other FFs from the same FD

The NIOSH investigators reviewed the following documents:

- Emergency Medical Services (EMS) and ED hospital records
- Voluntary annual medical evaluations from 2016 and 2017
- Records from the ENG's primary care provider (PCP) (2017-2020)
- Records from the ENG's endocrinologist (2016-2020)
- Death certificate

Fire Department

This FD is comprised of nearly 300 personnel, including 213 sworn firefighters and 19 pieces of fire apparatus. There are additionally over 40 full-time civilian personnel and over 30 part-time lifeguards. The FD has 6 fire stations covering approximately 30 square miles, serves a residential population of 153,000, and responds to nearly 28,000 alarm calls annually. The FD has transitioned from a nearly exclusive fire suppression department to a fire rescue and beach safety department. The FD is also home to a Cadet Program for youth ages 14-20.

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Membership and Training

The FD requires a minimum education of high school diploma or equivalent state firefighter certification. Additional requirements include current Certificate of Compliance from the Florida Bureau of Fire Standards and Training, State of Florida Emergency Medical Technician Certification, State of Florida Paramedic Certification (required within 4 years of hire date), and a valid state driver's license. Members must also pass a written test, a physical ability exam, and an oral interview with Command Staff. Once selected, incumbents are given a medical examination and a drug screening. State regulations from the Heart/Lung Bill require potential firefighters to sign an affidavit stating they do not smoke and have not smoked in the past year [Florida State Statue 112.18].

Preplacement/Periodic/Return to Work Medical Evaluations

The ENG had been a firefighter with the current FD since May 1999, a career of 23 years. There was not a required pre-placement medical examination when he was hired. Annual medical evaluations for incumbents are voluntary at this FD. For those who opt to have an annual medical evaluation, the FD contracts these out to a vendor who conducts all aspects including physician examination, blood tests, exercise stress test, etc.

Wellness/Fitness Programs

The FD provides fitness equipment at its station for the members' use but there is no formal fitness program in place. The FD reports encouraging and embracing an overall wellness culture.

Investigation

On June 3rd and 4th, the 58-year-old ENG reported for duty as normal, and completed tasks including testing out the FD's high-water truck (HWT). The ENG was the subject matter expert and certified to drive the FD's new high water rescue vehicle, or HWT. The ENG did not report feeling unwell to any of the staff at the station during the shift. On the morning of Sunday, June 5, 2022, the ENG left the fire station to return home after completing a routine 48-hour shift, during which he responded to 4 calls, 2 of the calls were canceled en route.

During the early hours of Monday, June 6, 2022, the ENG began to have chest pain and called 911. On arrival to the ED at 0505, the ENG reported non radiating substernal chest pain that had begun 30-45 minutes prior to arrival. En route, an electrocardiogram (ECG or EKG) showed an evolving heart attack, so arrangements were made to transport him directly to the cardiac catheterization (cath) laboratory. Shortly after arrival to the ED but before he could be transported to the cath lab, he went into cardiac arrest and was unable to be resuscitated. Time of death was noted at 0553. Because his chest pain began within 24 hours of ending his last shift, the ENG's death met the criteria for a Line of Duty Death (LODD) as defined by the Public Safety Officer Benefits Program.

Medical Findings

The death certificate provided by the Florida Department of Health did not note the ENG's cause of death due to Florida law governing release of this information, and no autopsy was performed. However, an acute myocardial infarction (heart attack) was evident from his initial EKG and

emergency department evaluation, so it is reasonable to conclude based on medical record review that a heart attack was his proximate cause of death.

The ENG underwent annual medical evaluations sponsored by the FD on March 10, 2016, and on June 28, 2017. These evaluations were comprehensive, and included a health screening questionnaire, physical exam and mental health assessment, physical fitness evaluation, and laboratory and imaging studies. The ENG also had a primary care physician (PCP), with records of their visits going back to February of 2017. He had a longstanding diagnosis of insulin dependent type 2 diabetes mellitus, but we were only able to obtain records from the endocrinologist he was managed by between 2017-2020.

At his last documented PCP visit before his death, the ENG's blood pressure was noted to be 130/74, which was generally consistent with prior PCP visits. He was already on at least one oral medication to lower blood pressure and was started on a second blood pressure medication at this visit. His height was measured at 5 ft 10 in (178 cm) and weight at 249 lbs. (112 kg), giving him a body mass index (BMI) of 35.7 kg/m^2. A BMI ≥ 30 kg/m2 represents obesity [CDC 2024c]. Both his PCP and endocrinologist had counseled him on diet and exercise since their first interactions with him in 2017 and 2016 respectively, both for weight management and to address his diabetes.

A primary concern throughout his medical history was diabetes control. His hemoglobin A1c (HbA1c), a measure of long-term blood sugar control, was 10% in 2016. A normal HbA1c is 5.6%, 5.7-6.4% indicates prediabetes, and diabetes is diagnosed with a HbA1c ≥ 6.5%. He was at that time on both oral diabetes medication and insulin. His HbA1c fluctuated over the next several years, reaching a low of 6.5% in 2019, but was 11.3% at his last PCP visit in 2020. He was very engaged in his diabetes management and underwent numerous adjustments to his diabetes medications. In this case the ENG used a continuous glucose monitoring system and an insulin pump and was enrolled in diabetes self-management education services.

The ENG did not have known heart disease prior to his death. At his FD-sponsored medical evaluation in 2017, he underwent an echocardiogram, which was normal. An exercise stress test did not reveal any concerns. He had some arterial plaque on a carotid ultrasound, which looks at blood vessels in the neck, but the degree of plaque (20-30%) was described as "mild". He was a former smoker, having quit smoking >20 years prior to his death, and had no family history of heart attack before age 65. His medical history was also significant for sleep apnea, which he managed with a continuous positive airway pressure (CPAP) device, and hyperlipidemia (high cholesterol), for which he was on a statin medication.

Discussion

Coronary Artery Disease

In the United States, atherosclerotic coronary artery disease (CAD), also known as atherosclerotic cardiovascular disease or ASCVD, is the most common risk factor for sudden cardiac death, usually due to myocardial infarction (heart attack) or abnormal heart rhythm leading to cardiac arrest [Myerburg and Castellanos 2008]. CAD refers to the presence of atherosclerotic plaque in the arteries delivering blood to the heart. Over years, often decades, plaque accumulates and eventually can narrow the coronary arteries to the point where blood flow is restricted, preventing the heart muscle from receiving sufficient oxygen [Libby 2013]. This can manifest as episodes of chest pain, or angina,

which often occur when the heart's oxygen demand increases during exertion. If the coronary arteries are severely occluded, a myocardial infarction, or heart attack, can result.

Many people experience a heart attack as chest pain. Other signs and symptoms of a heart attack may include feeling short of breath, weak, dizzy, or nauseated. Pain may occur in other areas such as the jaw, neck, upper back, or one or both shoulders/upper arms. Someone having a heart attack may also have diaphoresis (sweating) [CDC 2024a].

Heart attack signs and symptoms may present differently in diabetics; up to 43% of diabetics who experienced a heart attack reported not having any chest pain at all due to damage diabetes can cause to the nerves that sense pain [Kumar 2023]. The ENG did report chest pain, but the most frequent heart attack symptoms reported by diabetics are shortness of breath and diaphoresis.

Risk factors for heart attack can be classified as modifiable or non-modifiable. Modifiable risk factors that affect the heart's workload include high blood pressure (hypertension) and obesity, while those that impact the heart's blood supply include elevated cholesterol/low density lipoprotein (LDL) levels and diabetes. Other modifiable risk factors include smoking and physical inactivity. Non-modifiable risk factors include male sex, age >45 years, and family history of coronary artery disease. [CDC 2024b]. At the ENG's most recent visit to his primary care provider, on April 27, 2020, he was noted to have the following modifiable cardiac risk factors: diabetes, hypertension, elevated cholesterol (dyslipidemia), sleep apnea, and obesity. For additional information on diabetes, please see Appendix A of this report.

Type 2 Diabetes Mellitus

Diabetes is not a contraindication to performing the job of a firefighter, but it does introduce the need for additional monitoring, particularly if the firefighter is insulin dependent. Insulin (as well as some other medications used to treat diabetes), can lead to episodes of low blood sugar, or hypoglycemia. Hypoglycemic episodes are dangerous, and can lead to sudden weakness, confusion, seizure, loss of consciousness, or death. The ENG did require insulin for management of his diabetes and was therefore at risk of hypoglycemia while working. Irregular hours or long work shifts overlapping with planned mealtimes can complicate insulin dosing and predispose to hypoglycemia, as can the heavy physical exertion a firefighter might engage in during training or fire suppression activities. NFPA standard 1582 Section 9.8 outlines the recommended monitoring for firefighters with type 2 insulin dependent diabetes to ensure that the firefighter is under appropriate medical care. Diabetes can be challenging to control even when being compliant with the treatment regimens provided by their endocrinologists.

While insulin and other antihyperglycemic medications introduce their own risks, atherosclerosis is still the primary driver of impaired life expectancy in patients with diabetes, as chronically high blood sugar damages blood vessels. Unlike hypoglycemia, which is dangerous in the short term, hyperglycemia (high blood glucose levels) causes damage to the body over the course of years. It is estimated that diabetics are up to four times as likely as non-diabetics to develop ASCVD [Jyotsna et al 2023]. It is likely the ENG's diabetes contributed to ASCVD development.

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Dyslipidemia

Studies have demonstrated that blood lipid levels are important predictors of CAD and sudden cardiac death [Huxley et al. 2002; Stamler and Neaton 2008]. Unfavorable lipid levels contribute to blood vessel inflammation, which further encourages lipid accumulation and development of plaque [Higashi 2023]. This process is exacerbated by other factors contributing to blood vessel damage, such as diabetes in this case.

Patients with a 10-year ASCVD risk of > 7.5%, particularly those with diabetes, are often prescribed high-intensity statin therapy, both to lower their cholesterol and to stabilize existing atherosclerotic plaques to prevent an acute event like heart attack or stroke [AHA/ACC 2018; Lee et al. 2018]. The ENG had a 10-year ASCVD risk of 8.5%, and he was on a statin at the time of his death.

Occupational Medical Standards for Structural Firefighters

Nearly half of all firefighter duty-related deaths are due to cardiac causes. A study of data gathered at autopsy found that approximately 80% of firefighters who suffered duty-related sudden cardiac deaths had atherosclerosis and cardiomegaly (overall enlarged heart) or thickening of the heart muscle comprising the left ventricle [Smith et al. 2018].

Heart health assessment as per NFPA 1582: Starting at age 40 years of age, all firefighters should have an annual resting EKG. Additionally, annual cardiac risk assessment should be performed, using either the 2-year Framingham risk table or the 10-year risk calculator created jointly by the American College of Cardiology and the American Heart Association (ACC/AHA). Screening with either of these 2 methods should begin at age 40 for asymptomatic firefighters with no known history of ASCVD.

If a firefighter has a 2-year 2-4% risk of ASCVD or a 10% to <20% risk of ASCVD over the next 10 years, the firefighter should undergo symptom-limiting exercise stress testing (EST) with imaging [e.g. echocardiography, technetium (^{99m}Tc) sestamibi study] to at least 12 METs*.

If EST with imaging is positive, the firefighter should be referred to a cardiologist for further evaluation. Consult NFPA 1582 2022 version Chapter 9, Table 9.7 to determine restrictions on essential job tasks.

NFPA 1582 also recommends ASCVD risk assessment under other circumstances, including for firefighters < 40 years old with a high risk of ASCVD, those with insulin-dependent diabetes, etc.

*Note that this is different from the routine EST used to assess firefighters' aerobic fitness.

Recommendations

NIOSH offers 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.

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Recommendation #1: Consider requiring annual medical evaluations. Although annual medical evaluations are not required by department policy, NFPA 1582 recommends annual medical evaluations of members [NFPA 2022].

Discussion: NIOSH recommends that fire departments consider phasing in an annual medical evaluation program that is consistent with NFPA 1582, Chapter 8: *Annual Occupational Fitness Evaluation of Members*. This will ensure personnel can meet state and job requirements, and applies Chapter 9: *Occupational Medical Evaluations*, which covers tailored guidance for *Coronary Artery Disease and Hypertension* (Section 9.7), *Type 2 Diabetes That Requires Treatment with Insulin* (Section 9.8), etc. [NFPA 2022].

Many firefighters do not have their own PCP. Annual medical evaluations sponsored by their fire department could ensure they have routine medical evaluations by a licensed healthcare provider for early diagnoses of new medical conditions. This will allow for prompt treatment/management, increasing the chance of a long fire service career and better quality of life, while decreasing the risk of complications due to untreated medical issues [NFPA 2022].

This FD's voluntary annual medical evaluation was quite thorough. Participants received copies of all their test results, personalized exercise recommendations, and specific instructions on any abnormal results that needed to be followed up with their own healthcare providers. We recommend that all members participate in this voluntary program even if they have their own PCP as this could capture new issues that have arisen since their last visit to their PCP, facilitating earlier diagnosis and treatment initiation.

Recommendation #2: Ensure that firefighters with insulin dependent diabetes (type 1 or type 2) meet the provisions set forth in NFPA 1582 to be able to engage in firefighting tasks without restriction.

Discussion: Due to the collateral damage diabetes can do to many other body systems, it is important to ensure firefighters with diabetes are not experiencing any adverse effects that could put them or their crewmates at increased risk for an accident. Guidelines are provided in Annex D of NFPA 1582 [NFPA 2022].

Recommendation #3: Phase in a mandatory comprehensive wellness and fitness program for firefighters following guidance from NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters [NFPA 2015].

Discussion: Guidance from NFPA 1583, provides fire departments information on wellness and fitness programs to reduce risk factors associated with cardiovascular disease. The fire department has fitness equipment available to firefighters but does not have a formal fitness and wellness program for members. Health promotion programs for firefighters have been shown to reduce coronary heart disease risk factors and improve fitness levels [MacMillan et al 2020; Soteriades et al 2011]. One study found that cornerstones for a successful FD wellness program include presenting the program details in an engaging fashion, having a FD chief willing to adopt a wellness-fitness program, and a champion of the program in the FD [Kuehl et al 2013].

The International Association of Fire Fighters (IAFF) is currently developing the 5th edition of their Wellness-Fitness Initiative (WFI). This program began in 1997 as a collaboration with the International Association of Fire Chiefs (IAFC) with champions in 10 major cities in the US and

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Canada including New York City, Calgary, LA County, Miami-Dade, Seattle, etc.). More information on the WFI can be found IAFF-IAFC Fire Service Joint Labor Management Wellness-Fitness Initiative including the manual for the current 4th edition, Fit to Thrive exercise program, and overview of new items planned for the 5th edition.

Recommendation #4: Ensure that firefighters undergo cardiovascular disease screening as recommended in NFPA 1582 [NFPA 2022].

Discussion: NFPA 1582 also recommends ASCVD risk assessment starting at age 40 and under other circumstances, including for firefighters < 40 years old with a high risk of ASCVD, those with insulin-dependent diabetes, etc.

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Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program's Medical Team based in the Division of Field Studies and Engineering in Cincinnati, Ohio. This investigation was conducted, and this report was coauthored by Judith Eisenberg, MD, MS; Rob Saunders; Andrea Wilkinson, MS, ATC/LAT; and Alexandra Barger, MD, MPH. Dr. Eisenberg is a board certified Emergency Medicine physician, Mr. Saunders is a former NIOSH Technical Information Specialist, Ms. Wilkinson is a Health Scientist, and Dr. Barger is a board certified Internal Medicine physician. Mr. Saunders retired after 31 years with the Pike Township Fire Department, Indianapolis, Indiana. In addition to having served as a firefighter, paramedic, heavy rescue technician, and rescue diver, he has held the positions of Company Officer, Division Chief of Emergency Medical Services, Deputy Chief of Operations, and Fire Chief. Ms. Wilkinson is a fire service researcher and exercise physiologist. She is also an honorary Lieutenant for the Hanover Park Fire Department in Illinois.

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Appendix A

Deep Dive into Diabetes

There are currently approximately 38 million adults in the United States with diabetes and that number has nearly doubled in the past 20 years [CDC 2024d]. Diabetes occurs when the body is unable to manage glucose levels resulting in a constellation of medical issues. Insulin is produced by beta cells in the pancreas and its job is to transport glucose from the blood into cells where it is utilized as an energy source. Diabetes mostly presents in one of three forms. Type 1 occurs when the body produces an abnormal antibody that destroys beta cells and although it is usually diagnosed during childhood, it can develop at any age. Because the underlying cause results in the complete loss of insulin production capacity, patients with Type 1 diabetes are dependent on the administration of exogenous insulin to manage their glucose levels. Type II diabetes includes etiologies such as insulin resistance (insulin loses its effectiveness in binding and transporting glucose into cells), decreased production of insulin, or increased production of glucose by the liver. Type II diabetes usually begins in adulthood and depending on the severity, may be managed by diet alone but may also require oral medications or insulin to control blood glucose levels. A third type of diabetes may develop in the mother during pregnancy, and this is referred to as gestational diabetes [CDC 2024d; Powers et al 2022].

Medications used to manage diabetes range from those taken orally and include several different classes of pharmaceuticals that control blood sugars through different biochemical mechanisms such as metformin, semaglutide, empagliflozin, etc. Sometimes oral medications and diet modifications are not enough and patients with type II diabetes may need insulin to achieve control over their blood glucose levels. Insulin may be administered subcutaneously as needed with individual injections or infused as needed throughout the day using an insulin pump. Insulin comes in a variety of types with different times to peak glucose lowering effects and duration of action. Endocrinologists work with their diabetic patients to determine which type(s) of insulin and the dosing they need to achieve optimal control over their glucose levels and can create individualized insulin infusion programs using software in the insulin pumps. Insulin pumps can also administer additional insulin doses on demand if needed.

In the past, diabetics would monitor their glucose levels through fingersticks to obtain a few drops of blood that could be analyzed by home glucometers. In 1999, the FDA approved the first continuous glucose monitoring (CGM) system. These small discs ringed with tissue adhesive are usually placed on the back of the upper arm and have a small needle that pierces the skin that contains a sensor that measures glucose levels in the interstitial fluid which is a close proxy to blood glucose levels. A Bluetooth transmitter in the disc can relay the readings to a paired receiver in the form of a handheld reader or a smartphone app. Some CGM systems will continuously relay data to the receiver when it is in Bluetooth range while others will only transmit their data when the receiver actively scans the transmitter in the disc. Most of the systems currently available allow for them to remain in place for 10-14 days before requiring a changeout [Galindo and Aleppo 2020].

Bringing blood glucose levels down into normal range and maintaining those nominal levels are important, as prolonged hyperglycemia can result in damage to many different body systems. These effects are classified into vascular and non-vascular conditions. Vascular refers to issues involving blood flow. Uncontrolled diabetes can damage blood vessels of all sizes; damage to small blood

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vessels can cause blindness (by impairing blood flow to the retina), kidney failure, and nerve damage or neuropathy. Damage to larger blood vessels can result in decreased blood circulation to the extremities called peripheral arterial disease (PAD). The combination of decreased blood flow and decreased sensation due to neuropathy is why diabetics may have difficulty with knowing they have a wound or injury and healing it. Routine foot examinations are prudent in diabetics to detect any wounds or injuries they may not be able to see or feel so that treatment can be promptly initiated.

Glucose (sugar) and lipids (fats) are both sources of energy for the body so when the regulation of one is disrupted, it is not surprising that the other may be as well. This is why diabetics often face challenges in controlling their cholesterol levels. This results in an increased risk of atherosclerotic cardiovascular disease (ASCVD) from the buildup of cholesterol plaques inside the blood vessels supplying the heart. The presence of plaques along the inside walls of the blood vessel narrows the lumen (the open space inside the vessel where blood can flow), leading to an increased risk of heart attack as the blood supply to the heart muscle is reduced. A similar process occurs in blood vessels supplying the brain, leading to an increased risk of stroke. Nonvascular diabetic complications may include hearing loss, impaired cognitive function, dementia, infections, and skin changes. The mechanisms for the nonvascular complications are largely unknown [Powers et al 2022b].