1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

55-year-old Lieutenant Dies from Heart Attack While Responding to High-Rise Fire – Illinois

Executive Summary

On April 5, 2023, at 0656 hours, a 55-year-old lieutenant (LT), assigned to a tower ladder (T1), was dispatched to the scene of a high-rise structure fire. The T1's five members were assigned to serve as the fire investigation team (FIT). They found the fire had broken out on the 27th floor of a 1970s structure that had 35 floors and no sprinkler system. The LT and two other members of the FIT took the elevator to the 24th floor and climbed the stairs to the 27th floor. When the LT and other crewmembers arrived on the 27th floor, they forced entry into the apartment and discovered the severity of the fire.

The FIT noticed they were nearly out of air and began their descent down the stairs on their knees to the 25th floor where the medical team and additional supplies were staged. As the LT was descending the stairs, he encountered a firefighter (FF1) from the squad crew who was alone; FF1 witnessed the LT collapse. A Mayday was called, and emergency care began immediately as well as attempts to remove the LT from the building.

Emergency medical personnel reached the LT on the 11th floor at 0804, where another crewmember was administering cardiopulmonary resuscitation (CPR). CPR was interrupted for the duration of transport from the 11th floor out of the building to a waiting stretcher (the exact duration of interruption is unknown) and then resumed. He was immediately transported by ambulance to a nearby hospital, leaving the scene at 0825 and arriving in the emergency department (ED) at 0828. Four doses of epinephrine were administered pre-hospital. In the ED, lifesaving measures continued, including CPR, endotracheal intubation, and at least one additional dose of epinephrine. Due to prolonged downtime (30+ minutes), persistent asystole, and lack of cardiac activity on point-of-care ultrasound, he was pronounced dead at 0840.

Contributing Factors

- *Crew integrity*
- *Personnel accountability*
- *Occupational medical evaluations*

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Key Recommendations

The National Institute for Occupational Safety and Health (NIOSH) offers the following recommendations to reduce the risk of heart attacks and sudden cardiac arrest among firefighters at this and all fire departments across the country.

- *Key Recommendation #1: Ensure crew integrity is maintained when operating in an immediately dangerous to life and health (IDLH) atmosphere.*
- *Key Recommendation #2: Ensure that firefighters undergo cardiovascular disease screening as recommended in NFPA 1582. [NFPA 2022a].*
- *Key Recommendation #3: Implement a mandatory wellness and fitness program for fire department members that is consistent with NFPA 1583, Standard on Health-Related Fitness Programs for Fire Department Members [NFPA 2022b], and the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) Wellness-Fitness Initiative.*
- *Key Recommendation #4: Appropriately monitor air consumption and ensure self-contained breathing apparatuses (SCBA)s are modern and recognize 1/3 bottle alarm. Encourage personnel to complete air consumption drills to know how much work/rest/air is needed for each firefighter.*

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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Introduction

On April 5, 2023, at 0656 hours, a 55-year-old lieutenant (LT) collapsed on-scene while working a high-rise structure fire and was pronounced dead shortly after arriving at the local hospital. The U.S. Fire Administration announced this fatality through its firefighter fatality email notification service. The National Institute for Occupational Safety and Health (NIOSH) contacted the affected fire department (FD) 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 July 10–13, 2023.

During the investigation, the NIOSH investigators interviewed the following people:

- *Chief Medical Director*
- *Medical Examiner*
- *Deputy District Chief*
- *Battalion Chief*
- *FD Lieutenants and Captains*
- *FD Firefighters (FFs)*
- *FD Medics*
- *Fire Commissioner*
- *County Medical Examiner*
- *Assistant Deputy Commissioner*

The NIOSH investigators reviewed the following documents:

- *Physical fitness test results*
- *Primary care medical records*
- *Emergency department (ED) medical records*

- *Self-Contained Breathing Apparatus (SCBA) log*
- *Medical examiner investigations case report*
- *Report of postmortem examination*

Fire Department

At the time of the NIOSH investigation, this career FD consisted of approximately 5,100 full-time members. The FD is led by a fire commissioner with assistance from a first deputy fire commissioner. The first deputy commissioner oversees the four bureaus—operations, fire prevention, administrative services, and logistics. Each bureau is commanded by a deputy fire commissioner.

The FD serves a population of 2,697,000 and covers a land area of 228 square miles with 37 miles of rivers and waterways. FD members assigned to the operations division work a 24-on/48-off shift schedule with three platoons or shifts.

Each firehouse is assigned a captain. The captain is responsible for the fireground operations and management, firehouse budget, candidate training and evaluation, FF supervision, leave management, training schedules for each shift, apparatus maintenance, facility management and maintenance, public fire education, and fire inspections. The captain also serves as acting battalion chief as needed.

The fire department operates 5 districts, 25 battalions, 96 engine companies, 61 truck companies, and 4 squads. Each position on an engine, truck, and squad company has a unique identifier that is used for communication purposes (see Table 1). If an engine or truck company operates short (staffing of four instead of five), they operate under a variance. There are four squad companies, which are two-piece companies. Each squad company consists of a heavy rescue and a 55-foot snorkel.

Table 1. Staffing positions for each unit

Unit	Staffing Number	Positions
Engine Company	5	Officer; Engineer; Fire Fighter Pipeman (Pipe); Fire Fighter Heelman (Heel); Fire Fighter Hydrant
Truck Company	5	Officer; Driver; Fire Fighter Roof; Fire Fighter Entry; Fire Fighter Search
Squad Company	6	Squad Officer; Squad Driver; Squad Fire Fighter Rear; Snorkel Fire Fighter Search; Snorkel Driver/Search

The emergency medical services (EMS) division operates 80 advanced life support (ALS) ambulances, which are staffed with paramedics and emergency medical technicians. EMS field supervisors are assigned to each battalion to assist with staffing, logistical needs, and patient care.

The office of fire investigation (OFI) is mandated by state law and municipal ordinance to determine the cause and origin of all fires within the city. The OFI has five 24-hour response units, as well as a Major Incident Response Unit (MIRU) that is outfitted with tools and supplies to complement the 24-hour vehicles sent to investigate major incidents.

The FD has written policies and procedures that are available to all department members within their stations. These policies and procedures have been implemented and are enforced.

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Membership and Training

Illinois Office of the State Fire Marshal

The Illinois Office of the State Fire Marshal (OSFM) does not mandate minimum training requirements for FFs. However, the OSFM does maintain and oversee a Division of Personnel Standards and Education (DPSE) that promotes, encourages, and assists local governments to improve the levels of education and training standards for local FFs. While this program is strictly voluntary, the OSFM and the DPSE highly encourage local governments to adopt and complete FF certification programs. This includes offering a reimbursement program for FF training costs. Additional information about the DPSE's programs can be found on the division's website, and the General Assembly's Illinois Administrative Code, which includes training facilities, examinations and a current list of certifications (Office of the Illinois State Fire Marshal DPSE).

Fire Department

This career FD enacted requirements that exceeded the state's requirements. The FD hires candidates through the city's civil service process and gives recruitment tests for both single-role paramedics and FF positions. Recruits that pass the exam are placed on an eligibility list and that list is sorted in lottery order. The list is referred to as vacancies become available. Recruits must pass a background check, a physical ability test, and a medical examination that complies with *NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments* [NFPA 2022a].

The FD operates its own recruit training academy. Training lasts more than 6 months and exceeds the state fire training requirement. The curriculum includes the following:

Basic Operations Fire Fighter (NFPA 1001)

- Fire Service Vehicle Operator (FSVO) course (NFPA 1002)
- National Incident Management System (NIMS): Introduction to the Incident Command System (ICS 100)
- National Incident Management System (NIMS): An Introduction to the National Incident Management System (IS-700.B)
- National Fallen Firefighters Foundation, Courage to Be Safe Course
- Hazardous Materials Awareness and Hazardous Materials Operations (NFPA 1072)
- Farm Machinery Extrication

The recruit academy consists of more than 490 classroom and practical training contact hours. Recruits must pass written and practical testing per state protocol, successfully complete a physical training test at least three times during their program, and complete training with a flashover simulator.

Each recruit must also complete instruction in EMS and receive a National Registry of Emergency Medical Technicians (NREMT) Emergency Medical Technician (EMT) certification. This certification is a minimum of 120 hours of classroom and practical training and education.

FF candidates complete a probationary period after recruit school that entails nine months of continuous employment from their initial hire date. Candidates are further reviewed during the field evaluation period, which is a 12-month post-fire academy assignment on a company (engine or truck). The candidate is assigned to the station captain's shift.

During this time period, FFs must participate in a minimum of 2 hours of training per shift, which is documented by the company officer. All FFs must complete a 30-minute SCBA drill at the beginning of each work shift, which includes monitoring air management.

The battalion chief position is the highest tested rank in the department. Ranks above a battalion chief are appointed by the fire commissioner. The ranks of assistant deputy chief paramedic, deputy district chief, district chief, assistant deputy fire commissioner, deputy fire commissioner, and 1st deputy fire commissioner are also appointed by the fire commissioner. The fire commissioner is appointed by the mayor. The promotion process and respective requirements for the positions of lieutenant, captain, and battalion chief are shown below (see Table 2).

Table 2. Promotion process for each department rank

Position/Rank	Required Length of Service	Promotional Process	Training Post Promotion
Lieutenant	Requires 5 years of service as Firefighter	Written examination and oral interview	5-week training program at the fire academy
Captain	Requires 30 months of service as a Lieutenant	Written examination and oral interview	2-week training program that covers the National Fire Academy's *Incident Safety Officer* course; investigating motor vehicle accidents; the care, maintenance, and use of personal protective equipment (PPE); and incident command system (ICS) training
Battalion Chief	Requires 30 months of service as a Captain	Written exam	2-week officer candidate school program for battalion chiefs includes department communication procedures including the operational issues for portable radios, high-rise firefighting operations and practical drill, the use and management of rapid intervention crews, and Mayday procedures.

Preplacement/Periodic/Return to Work Medical Evaluations

The FD only provides physical examinations to new hires and special operators. Voluntary third-party physical abilities tests are offered.

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Physical Evaluation for Work Readiness

In October 2022, the LT underwent physical fitness testing by his FD. He was required to run 1.5 miles in less than 16 minutes and 21 seconds, perform a sit-and-reach to 12.8 inches, bench press 150.5 pounds, and complete 23 sit-ups. His performance was rated as "PASS" in all categories.

Personal Protective Equipment

At the time of the incident, the LT was wearing full structural firefighting turnout gear including helmet, protective hood, gloves, and boots. He was also wearing a SCBA. The structural firefighting turnout gear and SCBA were considered to be fully approved and properly functioning equipment.

Building Construction

The fire building was a 35-floor, high-rise residential condominium complex built in 1970. The floor of the fire scene did not have sprinklers. The building housed two sets of elevators: one on the north side and one on the south side.

Weather Conditions

At 0656 hours, the weather was fair with an approximate temperature of 71°F. The dew point was 62°F and the relative humidity was 73%. The winds were 16 mph from the south-southwest [Weather Underground 2023].

Investigation

On April 5, 2023, at 0656 hours, a 55-year-old LT, assigned to a tower ladder (T1), along with multiple other companies from the FD, was dispatched to the scene of a high-rise structure fire. An on-scene initial report was given over the radio at 0703, followed by several minutes of silence while staging was taking place. The five crewmembers of T1 were assigned to serve as the FIT. FIT is a specialized team designated to identify the source and cause of a fire. The fire was found to have broken out on the 27th floor of a 1970s structure that had 35 floors and no sprinkler system (see Appendix for floor diagram). There was a report of fire blowing out of a west window (Photo 1). The LT and two other members of the FIT took the elevator to the 24th floor. They then climbed the remaining three flights of stairs to the 27th floor. Taking the elevator to a lower floor is standard practice to provide a safety buffer and allow FFs to assess the scene and set up equipment prior to being near the active fire.

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An engine company (E1) was on the 26th floor preparing to deploy a hoseline. When the LT and other crewmembers arrived on the 27th floor, they forced entry into the apartment and discovered the severity of the fire—they noted dark, heavy, thick smoke and moderate heat. The FIT noticed they were nearly out of air so they began their descent down the stairs on their knees. At this time, there were three engine and two

Photo 1. Flames blowing out of the west window of 27th floor apartment building. Photo Courtesy of the Office of Fire Investigation

truck companies, all that were "on bells" or also low on air. All personnel moved to the 25th floor where the medical team was set up, per FD standard operating procedures, which required staging two floors below the scene of the fire. Shortly after, the use of the elevator was lost due to an error in securing the hoseline that caused drainage into the elevator shaft.

As the LT and FIT team were descending the stairs, they encountered FF1 from the squad crew who was alone. FF1 witnessed the LT trying to get out of his gear and then collapsing in the stairwell of the 25th floor. The medical team staged on the 25th floor was summoned away earlier to provide care for a separate Mayday call on the 23rd floor for a smoke inhalation injury and was not present to assist.

A Mayday was called. However, there was heavy radio traffic, and it was not believed to be acknowledged. A second Mayday was called although confusion was reported following the call; likely because a Mayday had already been called for an unrelated incident.

FF1 began emergency care immediately and attempted to remove the LT from the building via the stairs. The Rapid Intervention Team (RIT) met the LT around the 13th floor where they took over care. The Field Chief observed the LT being brought down and asked how long he had been down. The accompanying FFs advised 10–15 minutes and made the call to stop at the 11th floor to administer effective cardiopulmonary resuscitation (CPR with a metronome).

Emergency medical personnel reached the LT on the 11th floor at 0804, where the LT's gear had already been removed, and CPR was in progress by another crewmember. The initial cardiac rhythm recorded at 0805 was ventricular tachycardia. CPR was interrupted for the duration of transport from the 11th floor out of the building to a waiting stretcher (the exact duration of interruption is unknown) and then resumed. The LT was immediately transported by ambulance to a nearby hospital, leaving the scene at 0825 and arriving

in the ED at 0828. Four doses of epinephrine were administered pre-hospital. In the ED, heart rhythm monitoring showed asystole. Lifesaving measures continued, including CPR, endotracheal intubation, and at least one additional dose of epinephrine. Due to prolonged downtime (30+ minutes), persistent asystole, and lack of cardiac activity on point-of-care ultrasound, he was pronounced dead at 0840.

The LT's air consumption throughout the incident was recorded by his SCBA. His estimated breathing air consumption rate fluctuated between approximately 50–100 liters per minute (LPM) throughout the majority of his working time. The SCBA log shows that he was wearing the apparatus for approximately 25 minutes.

Fire Origin and Cause

The cause and origin of the fire was investigated by the authority having jurisdiction and was ultimately ruled accidental, starting from combustibles positioned too close to a heat-generating appliance.

Contributing Factors

Occupational injuries and fatalities are often the result of one or more contributing factors or key events. NIOSH investigators identified the following items as key contributing factors in this incident that ultimately led to the fatality:

- *Crew integrity*
- *Personnel accountability*
- *Occupational medical evaluations*

Cause of Death and Medical Findings

The medical examiner's report identified the cause of death as hypertensive-arteriosclerotic cardiovascular disease.

At the time of autopsy, the LT's height was 5 ft 10 in, with a weight of 234 pounds, giving a body mass index (BMI) of 33.6 kilograms per square meter (kg/m^2). BMI > 30 kg/m^2 is considered obese. A review of records from the LT's primary care physician for the years 2017–2023 shows his weight fluctuated from 206–242 lb, resulting in a BMI range of 29.6–34.7 kg/m^2.

Review of the LT's medical records showed diagnoses of type 2 diabetes mellitus and hyperlipidemia since at least 2017. He was seeing his physician regularly to manage these conditions. At the time of his death, he was not taking any prescription medications. He had a primary care visit in February 2023, about one month before his death, and had blood samples drawn for testing at that visit. His hemoglobin A1c, a measure of blood sugar level, was 7.4%, trending upward from 5.9% in 2018, indicating worsening blood sugar control. His cholesterol was elevated. The LT was not a smoker, and his blood pressure was within normal limits at his last primary care visit.

The LT was not known to have heart disease prior to his death. A resting electrocardiogram performed by his physician in 2017 showed normal sinus rhythm with no ST-T wave abnormalities noted. He underwent a low-dose chest computerized tomography (CT) scan for lung cancer screening in early 2023. These revealed no suspicious lung lesions but showed an incidental finding of significant coronary artery calcification (CAC). Consequently, the LT was given a cardiology referral, but he died approximately two weeks prior to his scheduled appointment.

At autopsy, his coronary arteries were noted to be markedly calcified, with the right coronary artery narrowed 70% by plaque, the left anterior descending artery narrowed 60%, and the left coronary artery by 90%. Additionally, his heart displayed biventricular dilatation, myocardial hypertrophy of the septum, and mild-to-severe atherosclerosis of the aorta. Vessels at the base of his brain were also noted to have severe atherosclerotic plaque deposition.

Discussion

Coronary Artery Disease

In the United States, atherosclerotic coronary artery disease (CAD) 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 obstructed, a myocardial infarction, or heart attack, can result.

A heart attack is usually diagnosed after observation of characteristic electrocardiogram findings, elevated levels of cardiac enzymes in the blood, or imaging showing arterial blockage. In this case, the LT did not survive long enough for measurement of cardiac enzymes or for imaging studies, and his heart rhythm did not allow diagnosis of a heart attack. However, the degree of coronary artery obstruction observed at autopsy (ranging from 60%–90% in his major coronary arteries) was sufficient for the medical examiner to conclude that atherosclerotic disease was the cause of his death.

At the time of this event, the LT was performing strenuous work in a stressful environment after climbing three flights of stairs. Typical adult air consumption at rest is 5–8 LPM, so his use of 50–100 LPM as recorded by his SCBA indicates he had higher oxygen requirements [Pleil et al. 2021]. A mismatch of increased oxygen demand by the heart to a supply limited by obstructed coronary arteries can trigger a heart attack or fatal arrhythmia. Stress and physical exertion are often inherent in firefighting work, making preventative care addressing chronic conditions especially important to preventing fatalities.

Risk factors for development of CAD can be grouped into modifiable and nonmodifiable categories. Nonmodifiable risk factors include age >45 years, male sex, and family history of CAD. Modifiable risk factors are diabetes mellitus, elevated blood cholesterol levels, smoking, high blood pressure, obesity, and physical inactivity [ACC/AHA, no date].

Since 1980, the American College of Cardiology (ACC) and the American Heart Association (AHA) have issued clinical practice guidelines for improving cardiovascular health. In 2013, the ACC/AHA released the Atherosclerotic Cardiovascular Disease (ASCVD) Risk Calculator. This calculator is designed to estimate the 10-year risk of ASCVD in adults with a low density lipoprotein (LDL) level between 70–189 milligram per deciliter (mg/dL) and without known ASCVD. Using this calculator, the LT's 10-year risk of ASCVD at the time of his last physician visit was 18.7%, and his lifetime risk was 69%. His LDL level of 216 mg/dL places him above the 189 mg/dL upper bound of the ASCVD Risk Calculator, suggesting that the calculator underestimates his risk [AHA/ACC, no date].

Though the LT was not diagnosed with CAD prior to his death, CAC was noted on a chest CT scan several weeks before he died. The presence of calcification was later confirmed at autopsy. CAC was at one time thought to be a benign process associated with normal aging, but more recently studies have shown that the

extent of CAC strongly correlates to the degree of atherosclerosis. Presence of CAC is associated with major adverse cardiovascular events. There is no specific medical intervention to treat CAC, but it is useful in risk estimation, as patients with a calcium score >400 by coronary computerized tomography angiography are shown to have worse clinical outcomes [Liu et al. 2015].

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 [NFPA 2022a]. Insulin, as well as some other medications to lower blood sugar, can lead to episodes of low blood sugar, or hypoglycemia. Hypoglycemic episodes can be very dangerous and can lead to sudden weakness, confusion, seizure, loss of consciousness, or death. In this case, however, the LT did not use insulin and was not on any antihyperglycemic medications. Therefore, the primary risk of his diabetes was the contribution of uncontrolled hyperglycemia to the development of cardiovascular disease.

Atherosclerosis is the primary driver of impaired life expectancy in patients with diabetes as chronically high blood sugar damages blood vessels [Leon and Maddox 2015]. Unlike hypoglycemia, which is dangerous in the short term, hyperglycemia causes damage to the body over the course of years. The autopsy findings of severe coronary and cerebral atherosclerosis are evidence that the LT was suffering vascular complications of longstanding diabetes.

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 [Lee et al. 2018]. The LT's 10-year risk was at least 18.7%, well over the threshold for concern. He had previously been on statin therapy but was not taking a statin at the time of his death.

Occupational Medical Standards for Structural Firefighters

Nearly half of all FF duty-related deaths are caused by sudden cardiac death. A study of data gathered at autopsy found that approximately 80% of firefighters who suffered duty-related sudden cardiac deaths had atherosclerosis, cardiomegaly (enlarged heart), or both [Smith et al. 2018].

NFPA 1582 recommends that, starting at age 40 years of age, all fire fighters should have an annual resting electrocardiogram (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 ACC/AHA. Screening with either of these two 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 (Metabolic Equivalency Task)*.

If Exercise Stress Test (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 under 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.

Operational Challenges

This incident encompassed unique operational challenges of getting the LT evacuated. The medical engine team working the incident was staged on the 25th floor; setting up medical two floors below the fire is standard operations for this FD. Unfortunately, a hoseline was not secured properly so water went into the elevator shafts and elevator use was lost. The LT could not be transported via elevator, and there was confusion as to the availability of medical crews to assist due to another on-site medical Mayday.

As the LT was descending the stairs, he encountered a FF from the squad crew who was alone. This FF witnessed the LT trying to get out of his gear and then collapsing. It is unknown if this FD has a policy for crew integrity during fire response. However, typically speaking, for safety and accountability, a FF should never be alone when working at a fire—thus crew integrity was compromised.

Recommendations

Recommendation #1: Ensure crew integrity is maintained when operating in an immediately dangerous to life and health (IDLH) atmosphere.

Discussion: *NFPA 1550*, *Standard for Emergency Responder Health and Safety* states in Paragraph 10.5.6 that company officers shall maintain an ongoing awareness of the location and condition of all company members. Paragraph 10.5.7 states that, where assigned as a company, members shall be responsible to remain under the supervision of their assigned company officer [NFPA 2024]. The International Association of Fire Chiefs (IAFC) Safety, Health, and Survival Section has redefined the Rules of Engagement for Structural Fire Fighting [IAFC 2012]. One of the objectives is to ensure that FFs always enter a burning building as a team of two or more members, and no FF is allowed to be alone at any time while entering, operating in, or exiting a building. Crew integrity is a critical element for FF survival.

Crew integrity starts with the company officer ensuring that all members of the company understand their riding assignment and have the proper personal protective equipment (PPE), tools, and equipment. Upon arrival at the incident, the company is given a task to perform by the incident commander. The company officer communicates to the members of the company what their assignment is and how they will accomplish their assignment. Just as the members of a company enter a hazardous environment together, they should leave together to ensure that crew integrity is maintained. If one member has to leave, the whole company leaves together [IAFC 2012]. It is the responsibility of every FF and company officer to stay in communication or contact with crew members at all times by visual observation, voice, or touch while operating in the hazard zone. All FFs should maintain the unity of command by operating under the direction of the incident commander, division/group supervisor, or their company officer at all times. The ultimate responsibility for crew integrity and ensuring no members get separated or lost rests with the company officer. If crew integrity is lost, FFs are placed at increased risk. A mayday should be called if any member cannot be accounted for as described above. Company officers should give an accountability report upon exiting the hazard zone to either Command or their assigned division or group supervisor

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Recommendation #2: Ensure that firefighters undergo cardiovascular disease screening as recommended in NFPA 1582. [NFPA 2022a].

Discussion: 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 ACC/AHA. Screening with either of these two 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 under 40 years old with a high risk of ASCVD, insulin-dependent diabetics, etc.

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

Recommendation #3: Implement a mandatory wellness and fitness program for fire department members that is consistent with NFPA 1583, Standard on Health-Related Fitness Programs for Fire Department Members, and the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) Wellness-Fitness Initiative.

Discussion: Guidance for FD wellness/fitness programs to reduce risk factors for cardiovascular disease and improve cardiovascular capacity is found in *NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters* [NFPA 2022b] and *The Fire Service Joint Labor Management Wellness-Fitness Initiative Candidate Physical Ability Test, 2nd Edition* [IAFF 2007]. Worksite health promotion programs have been shown to be cost effective by increasing productivity and reducing absenteeism, work-related injuries, and lost workdays [Aldana 2001; Stein et al. 2000]. Health promotion programs for firefighters have been shown to reduce coronary heart 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].

Recommendation #4: Appropriately monitor air consumption and ensure personnel recognize SCBA 1/3 bottle alarm. Encourage personnel to complete air consumption drills to know how much work/rest/air is needed for each firefighter.

Discussion: Compliance and familiarity with *NFPA 1404 Standard for Fire Service Respiratory Protection Training [NFPA, 2018]* will assist with outlining comprehensive training, SCBA user instructions, low-air alarm awareness, and other important training scenarios.

Air consumption drills are common in FF training. The purpose of this type of training is to identify and understand a FF's individual breathing limitations and air consumption through simulated fire ground activities. These drills allow FFs to further asses their levels of confidence and competence with their SCBA, as well as their ability to regulate breathing during physically strenuous activities. This also allows for increased exposure and training with SCBA to further understand individual air consumption needs as well as predicted work and rest periods.

References

ACC/AHA [n.d.]. ASCVD risk estimator plus. Washington, DC: American College of Cardiology. Dallas, TX: American Heart Association. Date accessed: April 10, 2025.

Aldana SG [2001]. Financial impact of health promotion programs: a comprehensive review of the literature. Am J Health Promot *15*(5):296–320.

Blevins JS, Bounds R, Armstrong E, Coast JR [2006]. Health and fitness programming for firefighters: does it produce results? Med Sci Sports Exerc *38*(5):S454.

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.

Higashi Y [2023]. Endothelial function in dyslipidemia: roles of LDL-cholesterol, HDL-cholesterol and triglycerides. Cells *12*(9):1293.

Huxley R, Lewington S, Clarke R [2002]. Cholesterol, coronary heart disease and stroke: a review of published evidence from observational studies and randomized controlled trials. Semin Vasc Med *2*(3):315–324.

IAFC [2012]. Rules of engagement for firefighter survival. Washington, DC: International Association of Fire Chiefs.

IAFF [2007]. The fire service joint labor management wellness-fitness initiative candidate physical ability test. 2nd ed. Washington, DC: International Association of Fire Fighters.

Lee S-E, Chang H-J, Sung JM, et al. [2018]. Effects of statins on coronary atherosclerotic plaques: the PARADIGM Study. JACC Cardiovasc Imaging *11*(10):1475–1484.

Leon BM, Maddox TM [2015]. Diabetes and cardiovascular disease: epidemiology, biological mechanisms, treatment recommendations, and future research. World J Diabetes *6*(13):1246–1258.

Libby P [2013]. Mechanisms of acute coronary syndromes and their implications for therapy. N Engl J Med *368*(21):2004–2013.

Liu W, Zhang Y, Yu C-M, Ji Q-W, Cai M, Zhao Y-X, Zhou Y-J [2015]. Current understanding of coronary artery calcification. J Geriatr Cardiol *12*(6):668–675.

Myerburg RJ, Castellanos A [2008]. Cardiovascular collapse, cardiac arrest, and sudden cardiac death. In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J, eds. Harrison's principles of internal medicine. 17th ed. New York: McGraw-Hill.

NFPA [2018]. NFPA 1404. Standard for Fire Service Respiratory Protection Training. Quincy, MA: National Fire Protection Association.

NFPA [2020]. NFPA 1710. Standard for organization and deployment of fire suppression operations, emergency medical operations, and special operations to the public by career fire department. Quincy, MA: National Fire Protection Association.

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

NFPA [2022b]. NFPA 1583. Standard on health-related fitness programs for fire fighters. Quincy, MA: National Fire Protection Association.

NFPA [2024]. NFPA 1550. Standard for emergency responder health and safety. Quincy, MA: National Fire Protection Association.

Pleil JD, Geer Wallace MA, Davis MD, Matty CM [2021]. The physics of human breathing: flow, timing, volume, and pressure parameters for normal, on-demand, and ventilator respiration. J Breath Res *15*(4):042002.

Smith DL, Haller JM, Korre M, Fehling PC, Sampani K, Porto LGG, Christophi CA, Kales SN [2018]. Pathoanatomic findings associated with duty-related cardiac death in US firefighters: a case-control study. J Am Heart Assoc *7*(18):e009446.

Stamler J, Neaton JD [2008]. The Multiple Risk Factor Intervention Trial (MRFIT)–importance then and now. JAMA *300*(11):1343–1345.

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*(12):1148–1155.

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 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 by Judith Eisenberg, MD, MS, and Rob Saunders. This report was coauthored by Judith Eisenberg, MD, MS; 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.

55-year-old Lieutenant Dies from Heart Attack While Responding to High-Rise Fire – Illinois
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Appendix A

High-Rise Floor Plan

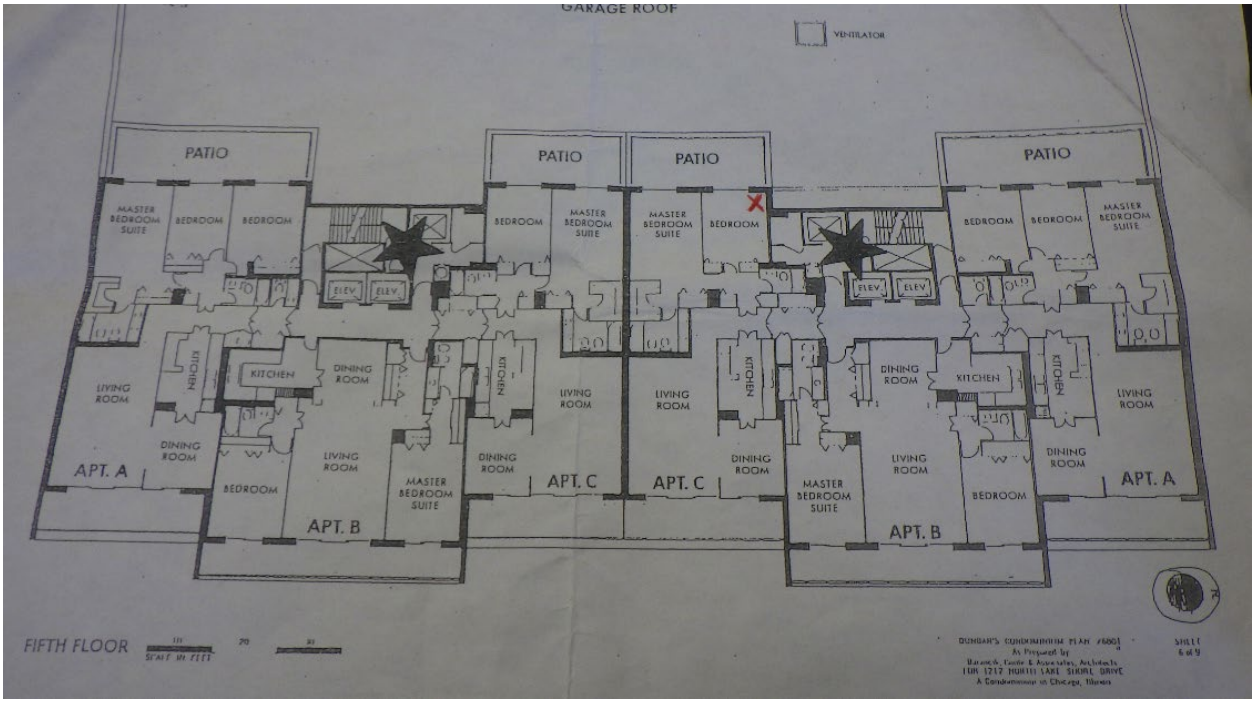

Figure 1. Apartment floor plan with a red "x" by a patio door showing where the fire initiated.