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NIOSH
Fire Fighter Fatality Investigation and Prevention Program

# Death in the line of duty...

*A Summary of a NIOSH fire fighter fatality investigation* *April 13, 2004*

## Fire Fighter Suffers Heart Attack at the Scene of a Structure Fire and Dies Two Months Later - Indiana

### SUMMARY

On December 15, 2002, at approximately 1750 hours, a 61-year-old male career Fire Fighter was at the scene of a fire in a single-family residence when he suffered a heart attack, medically known as a myocardial infarction. While awaiting coronary artery bypass graft (CABG) surgery, he suffered a second heart attack. Despite CABG surgery, his cardiac condition required extensive rehabilitation, and he was transferred to a long term care facility. Due to his deteriorating condition and poor prognosis, a do-not-resuscitate order was written. Twenty-three days later he suffered a cardiac arrest. Cardiopulmonary resuscitation (CPR) was not begun and he was pronounced dead on February 1, 2003. The death certificate listed "acute myocardial infarction" due to "atherosclerotic cardiovascular disease" as the immediate cause of death and "chronic obstructive pulmonary disease (COPD)" as a contributing factor. No autopsy was performed.

The following recommendations address some general health and safety issues. This list includes some preventive measures that have been recommended by other agencies to reduce the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. These selected recommendations have not been evaluated by NIOSH, but represent published research, or consensus votes of technical committees of the National Fire Protection Association (NFPA) or fire service labor/management groups.

- ***Consider requiring exercise stress tests (EST) for fire fighters with two or more risk factors for coronary artery disease (CAD)***
- ***Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting and the various components of NFPA 1582***
- ***Ensure fire fighters are physically capable of performing the essential job tasks of structural fire fighting***
- ***Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity***
- ***Perform an autopsy on all on-duty fire fighter fatalities***

Although unrelated to this fatality, the Fire Department should consider this additional recommendation based on safety and economic considerations:

- ***Provide <u>mandatory</u> annual medical evaluations to <u>ALL</u> fire fighters consistent with NFPA 1582 to determine their medical ability to perform duties without presenting***

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at **www.cdc.gov/niosh/firehome.html** or call toll free **1-800-35-NIOSH**

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***a significant risk to the safety and health of themselves or others***

- ***Discontinue the routine use of annual chest x-rays unless specifically indicated***

- ***Discontinue the routine use of annual electrocardiograms (EKG) unless medically indicated***

## INTRODUCTION & METHODS

On December 15, 2002, a 61-year-old male Fire Fighter suffered a heart attack at the scene of a single-family residence fire. He suffered another heart attack before undergoing CABG surgery. Due to his debilitating condition, he was transported to a long term care facility. On February 1, 2003, he suffered a cardiac arrest and died. NIOSH was notified of this fatality on February 3, 2003, by the United States Fire Administration. NIOSH contacted the affected fire department on February 27, 2003, to obtain further information and on August 19, 2003, to initiate the investigation. On September 15, 2003, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Indiana to conduct an on-site investigation of the incident.

During the investigation NIOSH personnel interviewed:

- The Fire Chief
- The Deputy Chief
- The IAFF local President
- The Fire Fighter's crew members
- The Fire Fighter's son

During the site-visit NIOSH personnel reviewed:

- Fire Department policies and operating guidelines
- Fire Department training records
- The Fire Department annual report for 2002
- Fire Department incident report
- Fire Department physical examination protocols
- Fire Department medical records
- Death certificate
- Past medical records of the deceased

## INVESTIGATIVE RESULTS

On December 15, 2002, the Fire Fighter reported for duty at his fire station (Station 1) at 0700 hours. He was assigned to Engine 72. During the shift, the crew performed apparatus check and station maintenance. The Fire Fighter went to bed at approximately 0830 hours. He arose at approximately 1630 hours, ate a sandwich, and subsequently went back to bed. According to his peers, the Fire Fighter would remain in his bunk at the station for extended periods of time when not working and had erratic eating habits.

At 1648 hours, Engine 70 (Station 2), Engine 71 and Engine 72 (Station 1), and Engine 73 (Station 3), a total of 12 personnel, were dispatched to a chimney fire in a single-family dwelling. (See photograph). Two ambulances (five personnel) were also dispatched. Units arrived on the scene at 1652 hours to find fire in the attic and chimney area. The Fire Fighter assisted with pulling two 3-inch supply lines from Engine 72 and connected them into Engine 70 while Engine 72 drove to the hydrant. The Fire Fighter then assisted in holding a ground ladder while Engine 71 crew members ventilated the roof. He then assisted in getting a second ground ladder (weighing approximately 24 pounds), placing it against the side of the home and held it as other crew members accessed the roof. While doing this, he passed a charged 1¾-inch hoseline up the ladder. He then helped retrieve a ventilation fan (weighing approximately 59 pounds) and carry it to the front door. He stayed with the ventilation fan a short time then walked approximately 20 yards to advise the Engine 71 Driver/Operator to open the tank-to-pump valve. As he spoke, the Driver/Operator noted his

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confused speech. The Driver/Operator alerted the Incident Commander (IC) of the Fire Fighter's actions. The IC advised crew members to assist the Fire Fighter.

Crew members walked the Fire Fighter to an on-scene ambulance at 1750 hours. The Fire Fighter presented with episodes of shaking and a decreased level of consciousness. His skin was pale, cool, and diaphoretic (sweaty). His blood pressure was 100/80 millimeters of mercury (mmHg). He was given oxygen by nasal cannula and attached to a cardiac monitor which revealed a heart rate of 60 beats per minute (borderline slow) with ectopy (irregular heart beats). A Chemstick (fingerstick glucose test) revealed a glucose level of 120 milligrams per deciliter (mg/dL) (normal is 70-110 mg/dL). The Fire Fighter denied having chest pains and refused an IV (intravenous access for medications). The ambulance departed the scene at 1759 hours and arrived at the hospital's emergency department (ED) at 1807 hours.

Evaluation in the ED revealed a pale, cool, clammy, and confused 61 year old male. His blood pressure was 89/46 mmHg and heart rate was 54 beats per minute. An electrocardiogram (EKG) revealed marked sinus bradycardia (49 beats per minute) and prominent inferior ST segment elevation (a diagnostic indicator of an acute heart attack located on the heart's inferior wall). He again refused an IV and further treatment, but crew members who had responded to the hospital convinced him to accept the treatment. He was given thrombolytic therapy, followed by Heparin. During his ED stay, he had periods of confusion and at one point appeared to have loss of limb strength on the right side. Head chromatography (CT) scanning showed no evidence of intracerebral bleeding. The Fire Fighter's relative neurologic deficit resolved spontaneously and he subsequently regained full consciousness. Following thrombolytic therapy, he had virtual resolution of his EKG abnormalities.

On December 17, the Fire Fighter underwent left heart cardiac catheterization which revealed significant blockage in his coronary arteries; specifically 50% stenosis in the left main coronary artery, diffuse disease in the left anterior descending coronary artery, 70% stenosis in the ramus intermedius artery, 70% stenosis in the left circumflex coronary artery, and 90% stenosis in the right coronary artery. Assessment of his left ventrical function could not be performed due to technical difficulties. A coronary artery bypass graft (CABG) was recommended.

An EKG on December 20 revealed a left anterior hemiblock (an electrical abnormality) and lateral wall subendocardial injury. An echocardiogram revealed mild inferobasilar hypokinesis with over-preserved left ventricular systolic function, moderate to severe aortic regurgitation and mild mitral regurgitation, and left ventricular diastolic dysfunction. The Fire Fighter did not want to remain in the hospital until the time of his CABG (December 24) and signed himself out of the hospital against medical advice on December 20.

On December 23, the Fire Fighter was seen in his cardiologist's office for some final pre-operative tests. Before all of these tests could be completed, he left and went home. A crew member went to the Fire Fighter's home to check on him later that day and as the Fire Fighter answered the door, he collapsed. The Fire Fighter spontaneously regained consciousness as the crew member requested an ambulance (1349 hours) from Dispatch. The ambulance arrived at the Fire Fighter's home at 1352 hours. Initial assessment revealed a blood pressure of 132/76 mmHg. A cardiac monitor revealed sinus rhythm with elevated T waves. The Fire Fighter did not complain of chest pain but he did have shortness of breath. The ambulance departed for the hospital at 1401 hours. Enroute, an IV was started. His blood pressure declined to 89/43 mmHg, medication was given, and his blood pressure increased. The

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ambulance arrived at the ED at 1410 hours. EKGs revealed normal sinus rhythm with sinus arrhythmia, inferior infarct, possibly acute, and new T wave abnormalities, and possible lateral ischemia. These later findings suggested the Fire Fighter had another heart attack. He was stabilized and sent to another hospital where his CABG was scheduled.

On December 24, the Fire Fighter underwent three vessel bypass complicated by poor cardiac output necessitating the temporary use of an intra-aortic balloon pump (IABP), persistent state of unconsciousness, and poor kidney function necessitating dialysis. A subsequent echocardiogram revealed hypokinesis of the mid to distal anteroseptum, mid septum, and apex, overall left ventricular systolic function in the range of 40 to 45%, no pericardial effusion, and mild mitral, aortic, and tricuspid insufficiency. To evaluate his neurologic status, an electroencephalogram was performed on December 30 which revealed "generalized slowing disorganization consistent with moderate-to-severe generalized encephalopathy which could be due to metabolic toxic or degenerative causes." It was felt by his neurologist that he had suffered a stroke with left hemiplegia. He remained in this hospital, his condition improving somewhat, until January 9, 2003, when he was transferred to a rehabilitation center.

Due to his deteriorating condition and poor prognosis, a do-not-resuscitate order was written. His condition continued to deteriorate until February 1 at 0900 hours when he died.

*Medical Findings*. The death certificate, completed by the Medical Examiner, listed "Atherosclerotic cardiovascular disease" due to "COPD" as the immediate cause of death. No autopsy was performed.

At his annual Fire Department medical evaluations from 1996 to 2002, he was noted to have:

1. Chronic obstructive pulmonary disease (COPD) due to cigarette smoking (he smoked approximately one pack per day for approximately 45 years). Spirometry testing in 2002 revealed abnormal results in forced expiratory volume at one second ($FEV_1$) of 57% (normal e" 80%), forced vital capacity (FVC) of 83% (normal e" 80%), and a $FEV_1$/FVC ratio of 69 (normal e" 70).

2. Hypercholesterolemia. His total cholesterol level ranged between 217 and 255 milligrams per deciliter (mg/dL)(normal < 200 mg/dL). His total cholesterol/high density lipoprotein (Chol/HDL) ratios were normal.

3. Hypertension. His blood pressure ranged between 150/80 and 188/90 mmHg.

4. Abnormal EKG. A last EKG in 2001 revealed sinus rhythm, left axis deviation, consider septal infarction, and possible left ventricular hypertrophy.

He had been advised to stop smoking and referred to his primary care physician for blood pressure control, cholesterol control, and treatment of his COPD. There was no indication that he sought or received any type of follow-up medical care.

According to his son and crew members, immediately prior to this incident, the Fire Fighter had no complaints of chest pains or any symptoms suggestive of acute heart-related problems.

## DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this combination Fire Department consisted of 57 uniformed personnel (32 career and 25 volunteer). The FD served a population of 20,000 in an area of

9.4 square miles. There are three fire stations (two career and one volunteer). Career fire fighters work the following schedule: 24 hours on-duty, 24 hours off-duty, 0700 hours to 0700 hours, for three tours, then are off-duty for three days.

In 2002, the FD responded to 875 calls: 28 structure fires, 31 vehicle fires, 24 other fires, 18 brush/grass fires, 13 dumpster fires, 12 trash/rubbish fires, 7 overpressure rupture/overheat calls, 99 hazardous condition calls, 207 false alarm/false calls, 78 good intent calls, 26 service calls, 14 other miscellaneous calls, 5 severe weather calls, and 313 emergency medical calls.

*Training*. The Fire Department requires all new fire fighter applicants to have two years fire fighting experience or two years of college and be a state-certified Emergency Medical Technician, pass a physical agility test, a written test (ranked by score), and an oral interview prior to being hired contingent on passing: 1) a pre-placement physical exam, and 2) a psychological examination.

Recurrent training occurs daily on each shift. The FD trains the new fire fighter to the Fire Fighter I and II levels within one year of being hired. The State minimum requirements for fire fighter certification are 24 hours basic firefighter training and Hazardous Materials First Responder. There is no State requirement for fire fighter recertification. The Fire Fighter was certified as a Fire Fighter First Class, First Aid, and CPR. He had 30 years of fire fighting experience.

*Pre-placement Evaluations*. The FD requires a pre-placement medical evaluation for all fire fighter candidates, regardless of age. Components of the evaluation include

- A complete medical history
- Physical examination
- Vital signs
- Vision screening
- Hearing test
- Complete Blood Count
- Liver function test
- Urinalysis dipstick
- Chest x-ray
- Electrocardiogram (EKG)
- Human Immunovirus (HIV) test
- Syphilis serology
- Tuberculosis skin test
- Pulmonary Function Test

These evaluations are performed by a contract physician hired by the City, who then makes a decision regarding medical clearance for fire fighting duties. This decision is forwarded to the City Human Resources Director.

*Periodic Evaluations*

Annual medical evaluations are required by this Department for all fire fighters. Components of this screening include the following

- A complete medical history
- Physical examination
- Vital signs
- Complete Blood Count
- Spirometry
- Resting EKG
- Chest-x-ray
- Hearing test
- Vision test

If the screening identifies any health problems, the fire fighter is advised to see their personal physician. The Fire Fighter had his last FD physical evaluation in October 2002 and he was cleared for duty.

Medical clearance for respirator use is required. If an employee is injured at work, or is ill and off work for more than two consecutive shifts, the employee is evaluated by their personal physician, who forwards their recommendation regarding "return to

work" to the City contract physician, who makes the final determination.

Exercise (strength and aerobic) equipment is located in the fire stations. Voluntary wellness/fitness programs are in place for the FD. Health maintenance information is available from the City. There is no annual physical ability test. The Fire Fighter did not participate in fitness activities.

## DISCUSSION

In the United States, coronary artery disease (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death.[1] Risk factors for its development include age over 45, male gender, family history of coronary artery disease, smoking, high blood pressure, high blood cholesterol, obesity/physical inactivity, and diabetes.[2] The victim had five of these risk factors (age over 45, male gender, smoking, high blood pressure, and high blood cholesterol).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.[3] However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.[4] Heart attacks typically occur with the sudden development of complete blockage (occlusion) in one or more coronary arteries that have not developed a collateral blood supply.[5] This sudden blockage is primarily due to blood clots (thrombosis) forming on the top of atherosclerotic plaques. While no autopsy was performed, the Fire Fighter had a confirmed heart attack during his support of fire suppression activities at a residential structure fire. His heart attack was diagnosed by EKG and cardiac iso-enzymes.

Firefighting is widely acknowledged to be one of the most physically demanding and hazardous of all civilian occupations.[6] Firefighting activities are strenuous and often require fire fighters to work at near maximal heart rates for long periods. The increase in heart rate has been shown to begin with responding to the initial alarm and persist through the course of fire suppression activities.[7-9] Even when energy costs are moderate (as measured by oxygen consumption) and work is performed in a thermoneutral environment, heart rates may be high (over 170 beats per minute) owing to the insulative properties of the personal protective clothing.[10] Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.[11-14] While at the fire scene, the Fire Fighter assisted with pulling two 3-inch supply lines and connected them into an Engine, assisted with ventilation duties, assisted in getting a ground ladder and passing up a charged hoseline to the roof, and helped retrieve a ventilation fan and carry it to the front door. This is considered a moderate level of physical exertion.[6,15] The physical stress of responding to the alarm and performing a moderate level of physical exertion, coupled with his underlying atherosclerotic CAD probably contributed to this fire fighter's initial heart attack. Additionally, refusing initial treatment, leaving the hospital, and leaving his cardiologist's office prior to completion of medical testing, thus delaying medical treatment, may have contributed to his second heart attack. All these factors combined probably contributed to his subsequent cardiac arrest and death.

To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, the NFPA has developed guidelines entitled "Standard on Comprehensive Occupational Medical Program for Fire Departments," otherwise known as NFPA 1582.[16] To screen for CAD, NFPA 1582 recommends an EST for asymptomatic fire fighters with two or more risk factors for CAD [family history of premature (less than age 60) cardiac event, hypertension (diastolic blood pressure greater than 90 mmHg), diabetes mellitus, cigarette smoking, and

hypercholesterolemia (total cholesterol greater than 240 mg/dL)].[16] This recommendation is consistent with recommendations from the American Heart Association/ American College of Cardiology (AHA/ACC) and the Department of Transportation (DOT) regarding EST in asymptomatic individuals.[17,18]

On the other hand, the U.S. Preventive Services Task Force (USPSTF) indicates that there is insufficient evidence to recommend screening middle age and older men or women in the general population, however, "screening individuals in certain occupations (pilots, truck drivers, etc.) can be recommended on other grounds, including the possible benefits to public safety."[19]

Since the deceased was male, over 45 years of age, and had three risk factors for CAD, the performance of an EST is recommended by NFPA 1582 and the AHA. If an EST had been performed, his CAD might have been detected earlier, resulting in further evaluation and treatment prior to his heart attack, and possibly preventing his sudden cardiac death.

## RECOMMENDATIONS

The following recommendations address health and safety generally. This list includes some preventive measures that have been recommended by other agencies to reduce the risk of on-the-job heart attacks and sudden cardiac arrest among fire fighters. These recommendations have not been evaluated by NIOSH, but represent published research, or consensus votes of technical committees of the NFPA or fire service labor/ management groups.

***Recommendation #1: Consider requiring exercise stress tests for fire fighters with two or more risk factors for coronary artery disease (CAD).***

NFPA 1582, IAFF/IAFC wellness/fitness initiative, and the American Heart Association recommend EST for fire fighters with two or more CAD risk factors.[16,17,20] The EST could be conducted by the fire fighter's personal physician or the City contract physician. If the fire fighter's personal physician conducts the test, the results must be communicated to the City physician, who should be responsible for decisions regarding medical clearance for fire fighting duties.

***Recommendation #2: Ensure that fire fighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting and the various components of NFPA 1582.***

Physicians providing input regarding medical clearance for fire fighting duties should be knowledgeable about the physical demands of fire fighting and familiar with the consensus guidelines published by NFPA 1582.[16] The pre-placement physical examination and the periodic physical evaluation clearance for duty decisions require knowledge of both the employee's medical condition and the employee's job duties. The City contract physician must be aware of essential job tasks and NFPA 1582. Therefore, NIOSH recommends that the FD provide the City contract physician with information contained in NFPA 1582 regarding job duties and clearance for duty guidelines.

***Recommendation #3: Ensure fire fighters are physically capable of performing the essential job tasks of structural fire fighting.***

NFPA 1500 requires fire department members who engage in emergency operations to be annually evaluated and certified by the fire department as meeting the physical performance requirements identified in paragraph 8-2.1.[21]

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***Recommendation #4: Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.***

Physical inactivity is the most prevalent modifiable risk factor for CAD in the United States. Additionally, physical inactivity, or lack of exercise, is associated with other risk factors, namely obesity and diabetes.[22] NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.[21] NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters, provides the minimum requirements for a health-related fitness program.[23] In 1997, the International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) published a comprehensive Fire Service Joint Labor Management Wellness/Fitness Initiative to improve fire fighter quality of life and maintain physical and mental capabilities of fire fighters. Ten fire departments across the United States joined this effort to pool information about their physical fitness programs and to create a practical fire service program. They produced a manual and a video detailing elements of such a program.[20] The Fire Department and the Union should review these materials to identify applicable elements for their Department. Other large-city negotiated programs can also be reviewed as potential models. Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.[24-26] A similar cost savings has been reported by the wellness program at the Phoenix Fire Department, where a 12-year commitment has resulted in a significant reduction in their disability pension costs.[27]

***Recommendation #5: Perform an autopsy on all on-duty fire fighter fatalities.***

In 1995, the United States Fire Administration (USFA) published the Firefighter Autopsy Protocol.[28] This publication hopes to provide "a more thorough documentation of the causes of firefighter deaths for three purposes:

(1) to advance the analysis of the causes of firefighter deaths to aid in the development of improved firefighter health and safety equipment, procedures, and standards;

(2) to help determine eligibility for death benefits under the Federal government's Public Safety Officer Benefits Program, as well as state and local programs; and

(3) to address an increasing interest in the study of deaths that could be related to occupational illnesses among firefighters, both active and retired."

***Recommendation #6: Provide mandatory annual medical evaluations to ALL fire fighters consistent with NFPA 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.***

This finding did not contribute to the death of this fire fighter, but was identified by NIOSH during the investigation. Guidance regarding the content and frequency of periodic medical evaluations and examinations for fire fighters can be found in NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments,[16] and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) wellness/fitness initiative.[20] The Department is not legally required to follow any of these standards. Nonetheless, we recommend the City and Union **work together** to establish

the content and frequency in order to be consistent with the above guidelines.

The success of medical programs hinges on protecting the affected fire fighter. The Department must **1)** keep the medical records confidential, **2)** provide alternate duty positions for fire fighters in rehabilitation programs, and **3)** if the fire fighter is not medically qualified to return to active fire fighting duties, provide permanent alternate duty positions or other supportive and/or compensated alternatives.

***Recommendation #7*: *Discontinue the routine use of annual chest x-rays unless specifically indicated.***

This finding did not contribute to the death of this Fire Fighter but was identified by NIOSH during the inspection.

Specifically, according to NFPA 1582, "the use of chest x-rays in surveillance activities in the absence of significant exposures, symptoms, or medical findings has not been shown to reduce respiratory or other health impairment. Therefore, only pre-placement chest x-rays are recommended."[16] The chest x-rays being conducted by the Fire Department for the Hazmat and the Medical Strike Team expose incumbents to unnecessary radiation and represent an unnecessary expense for the Fire Department, and are not recommended by the OSHA Hazmat standard unless specifically indicated by the medical/occupational history.[29]

***Recommendation #8: Discontinue the routine use of annual electrocardiograms (EKG) unless medically indicated.***

This finding did not contribute to the death of this Fire Fighter but was identified by NIOSH during the inspection.

Specifically, according to NFPA 1582, "periodic resting electrocardiograms have not been shown to be useful but can be reasonable as a member's age increases."[16] The stress EKG is a much better tool to identify heart arrhythmias. Therefore, only pre-placement EKGs are recommended unless medically indicated. The EKGs being conducted by the Fire Department represent an unnecessary expense for the Fire Department.

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## INVESTIGATOR INFORMATION

This investigation was conducted by and the report written by, Tommy N. Baldwin, MS, Safety and Occupational Health Specialist. Mr. Baldwin, a National Association of Fire Investigators (NAFI) Certified Fire and Explosion Investigator, an International Fire Service Accreditation Congress (IFSAC) Certified Fire Officer I, and a Kentucky Certified Fire Fighter and Emergency Medical Technician (EMT), is with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component located in Cincinnati, Ohio.

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**Photograph.** Residential structure involved in the incident