



On-Duty Driver/Operator Dies in Sleep - Indiana

SUMMARY

On June 2, 1998, a 44-year-old male Driver/Operator died while asleep during the night while on duty. During his shift, he had responded to a fire in a garage and an outdoor rubbish fire. At both responses, the victim served as Driver/Operator of an Engine company. The death certificate, completed by the County Coroner, listed "probable arrhythmia due to hypertrophic cardiomyopathy, fibrosis of sinoatrial node" as the immediate cause of death.

The following recommendations address some general health and safety issues. It is unlikely, however, that any of these recommendations could have prevented the sudden cardiac arrest and subsequent death of this Driver/Operator. 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 labor/management groups within the fire service. In addition, the recommendations are presented in a logical programmatic order and are not listed in a priority manner. Issues relevant to this Fire Department include

- ***Fire fighters should have mandatory annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.***
- ***Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by offering a wellness/fitness program for***

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

- ***Exercise stress tests should be incorporated into the Fire Department's medical evaluation program.***
- ***Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatus (SCBA).***

INTRODUCTION AND METHODS

On June 2, 1998, a 44-year-old male on-duty Driver/Operator died while asleep during the night. On April 28, 2000, NIOSH contacted the affected Fire Department to initiate the investigation. On May 9, 2000, a Safety and Occupational Health Specialist and an Epidemiologist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Indiana to conduct an on-site investigation of the incident.

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. 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:

<http://www.cdc.gov/niosh/firehome.html>

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During the investigation NIOSH personnel interviewed the

- Fire Chief
- Chief Fire Investigator
- Union representative
- Crew members on duty with the victim
- Victim's wife

During the site visit NIOSH personnel reviewed

- Fire Department incident report
- Fire Department policies and operating guidelines
- Fire Department training records
- Fire Department annual report for 1998
- Fire Department physical examination protocols
- Death certificate
- Autopsy record
- Past medical records of the deceased

INVESTIGATIVE RESULTS

Incident. On June 1, 1998, the victim reported for work at 0730 hours. The morning was spent conducting an inventory of the apparatus and daily station cleaning. Afterward, in-house training was conducted. At 1231 hours, the involved Fire Department was dispatched to a fire in a detached garage. Three Engines and one aerial (a total of 13 personnel, including the victim) responded to the call. Companies were on the scene 36 minutes. No other activities were conducted during the day. The victim went to bed at approximately 2300 hours. At 0050 hours, the Fire Department was dispatched to an outdoor rubbish fire. Two Engines (8 personnel, including the victim) responded. Companies were on the scene for 22 minutes. After returning to the station, crew members went to bed. At approximately 0230 hours, several crew members were awakened by the restlessness and moaning of the victim, who appeared to be having a bad dream. There was no indication that the victim was having chest pain or any breathing difficulty. At approximately 0630 hours, crew members awoke and prepared to go off shift.

At 0700 hours, the station alert test was conducted, but the victim still had not emerged from the bunkroom. Crew members went to the bunkroom to check on the victim and found him unresponsive, pulseless, not breathing, and cool to the touch. Given these clinical findings, CPR was not performed. The Battalion Chief on duty notified Dispatch of an apparent death. Dispatch notified the ambulance, which responded. The coroner was requested a short time later and responded, pronouncing the victim dead at the fire station. The exact time of death was not determined.

Medical Findings. The death certificate, completed by the County Coroner, listed "probable arrhythmia due to hypertrophic cardiomyopathy, fibrosis of sinoatrial node" as the immediate cause of death. Since the Driver/Operator was not engaged in fire suppression activities, his blood was not tested for carbon monoxide poisoning (carboxyhemoglobin levels).

Pertinent findings from the autopsy, performed by the Medical Examiner on June 2, 1998, are listed below:

- Moderate coronary artery disease
 - Up to 50% stenosis of the proximal circumflex artery
 - Up to 50% stenosis of the mid left anterior descending coronary artery
 - Intramyo-cardial tunneling of coronary artery
 - Fibrosis of the sinoatrial node
- Concentric hypertrophic cardiomyopathy
 - Diminished left ventricular cavity
 - Dilated right ventricle
 - Significant myocyte hypertrophy with nuclear enlargement and fiber disarray involving the septum of both ventricles
- Biventricular and ventricular septum hypertrophy
- Severely congested lungs bilaterally with edema



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- Hepatosplenomegaly with passive congestion
- Hashimoto's thyroiditis

DESCRIPTION OF THE FIRE

DEPARTMENT

At the time of the NIOSH investigation, the Fire Department consisted of 120 uniformed career personnel and served a population of 73,000 residents (plus 11,000 college students during the school year) in a geographic area of 36 square miles. There are seven fire stations. Fire fighters work the following schedule: 24 hours on duty and 24 hours off duty for three tours, then off duty for 4 days.

In 1998, the Department responded to 1,820 calls: 101 rescue (EMS and mutual aid) calls, 509 fire calls (132 structure fires, 92 vehicle fires, 145 rubbish fires, 100 brush fires, 40 other fires), 391 false alarms, and 819 other calls. The victim had responded to two calls during the shift on which he died.

Training. The Fire Department requires all new fire fighters to pass a physical agility test and a preemployment physical examination before being hired. Once hired, fire fighters must complete the basic 24-hour State fire fighter training before riding fire apparatus. Once recruit training is completed, fire fighters are assigned to a shift. Subsequent training is conducted on shift. There is no state requirement for annual recertification. The victim was certified as a Driver/Operator, and he had 12 years of fire fighting experience.

Preemployment/Preplacement Evaluations. The Department requires a preemployment/preplacement medical evaluation for all new hires, regardless of age. Components of this evaluation for all applicants include the following:

- A complete medical history
- Height, weight, and vital signs
- Physical examination

- Blood tests: Complete blood count with differential (CBC), fasting glucose, BUN, creatinine, liver function test, Human Immunodeficiency Virus (HIV) test, syphilis serology
- Urine Tests: Urinalysis, Urine drug screen
- PPD skin test (for tuberculosis)
- Chest X-ray
- 12-lead resting electrocardiogram (ECG)
- Audiometry
- Pulmonary function test
- Vision test: Color vision, stereopsis, fusion, horizontal field vision, visual acuity

These evaluations are performed by a contract physician hired by the City. Once this evaluation is complete, the physician makes a determination regarding medical clearance for fire-fighting duties and forwards this decision to the City's personnel director.

Periodic Evaluations. Voluntary periodic medical evaluations are offered by this Department to all fire fighters. Fire fighters under the age of 40 are eligible to be evaluated every other year, and fire fighters age 40 and over are eligible annually. The content of this evaluation includes the following:

- A complete medical history
- Height, weight, and vital signs
- Physical examination
- Blood Tests: Complete blood count with differential(CBC), chemistry 21 profile, HDL cholesterol
- Urinalysis
- TB test, if appropriate
- Chest X-ray, if indicated
- 12-lead resting EKG
- Treadmill fitness test with ECG and blood pressure monitoring
- Flexibility evaluation
- Body composition analysis
- Audiometry



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- Vision test: Color vision, stereopsis, fusion, horizontal field vision, visual acuity
- Pulmonary function test

The victim's last Fire Department medical evaluation was in 1996. Borderline high cholesterol was noted, and he was cleared for fire-fighting duties. According to records available to NIOSH, this evaluation included a medical history, a resting EKG, and an exercise stress test (EST), the results of which were not different from previous examinations. If an employee is injured at work or ill, the employee is evaluated and must be cleared for "return to work" by the fire fighter's private physician, and the clearance is then reviewed by the City physician.

Although all fire stations have exercise (strength and aerobic) equipment, primarily purchased by the Fire Department, the Department does not have an organized (voluntary or required) fitness/wellness program.

DISCUSSION

The autopsy attributes the victim's death to a primary heart arrhythmia, due to his hypertrophic cardiomyopathy. The most common cause for an enlarged heart (cardiomyopathy) is ischemic or hypertensive (chronic high blood pressure) heart disease.¹ There was no evidence the victim had a remote or recent heart attack. The victim was never diagnosed with high blood pressure during his numerous biannual physical examinations, but he did have 50% blockage of his coronary arteries on autopsy. This suggests a less common reason for his enlarged heart, hypertrophic cardiomyopathy. This condition is associated with sudden death in young men.¹ It is a hereditary disease (autosomal dominant) with genetic heterogeneity. The findings on autopsy (concentric hypertrophic cardiomyopathy with diminished left ventricular cavity, dilated right ventricle, and significant myocyte hypertrophy with

nuclear enlargement and fiber disarray involving the septum of both ventricles) are consistent with this diagnosis.² First-degree relatives (parents, brothers and sisters) and offspring (sons and daughters) should seek medical consultation regarding a screening EKG and an echocardiogram to diagnose the condition since it is an inherited and treatable condition.¹ This advice has been communicated to the victim's family.

The Department conducted extensive preemployment/preplacement medical evaluations but did not require annual medical evaluations. To reduce the risk of heart attacks and sudden cardiac arrest among fire fighters, the National Fire Protection Association (NFPA) has developed guidelines entitled "Medical Requirements for Fire Fighters and Information for Fire Department Physicians," otherwise known as NFPA 1582.³ They recommend, in addition to screening for risk factors for CAD, an exercise stress EKG, otherwise known as an exercise stress test (EST). The EST is used to screen individuals for CAD. Unfortunately, it has problems with both false negatives (inadequate sensitivity) and false positives (inadequate specificity), particularly for asymptomatic individuals (individuals without symptoms suggestive of angina).^{4,5} This has led other expert groups to **not** recommend EST for asymptomatic individuals without risk factors for CAD.^{6,7}

When these asymptomatic individuals **have** risk factors for CAD, however, recommendations vary by organization. The American College of Cardiology/American Heart Association (ACC/AHA) identifies two groups for EST: (1) men over the age of 40 with a history of cardiac disease (as a screening test prior to beginning a strenuous exercise program), and (2) men over age 40 with one or more risk factors.⁶ They define five risk factors for CAD: hypercholesterolemia (total cholesterol greater than 240 mg/dL), hypertension (systolic greater than 140



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mm Hg or diastolic greater than 90 mm Hg), smoking, diabetes, and family history of premature CAD (cardiac event in first-degree relative less than 60 years old).⁶ The U.S. Preventive Services Task Force (USPSTF) does not recommend EST for asymptomatic individuals, even those with risk factors for CAD; rather, they recommend the diagnosis and treatment of modifiable risk factors (hypertension, high cholesterol, smoking, and diabetes).⁷

These recommendations change for individuals who might endanger public safety if an acute episode were experienced, or for those who require high cardiovascular performance such as police and fire fighters. The National Fire Protection Association (NFPA) recommends EST for fire fighters without CAD risk factors at age 40 and for those with one or more risk factors at age 35.³ NFPA considers risk factors to be family history of premature (less than age 55) cardiac event, hypertension, diabetes mellitus, cigarette smoking, and hypercholesterolemia (total cholesterol greater than 240 or HDL cholesterol less than 35).³ The EST should then be performed on a periodic basis, at least once every 2 years.³ The ACC/AHA indicates that data are insufficient to justify periodic exercise testing in people involved in public safety; however, as mentioned previously, they recommend that men over age 40 with a history of cardiac disease be screened before beginning a strenuous exercise program.⁶ Fire-suppression activities involve strenuous physical activity; therefore, the ACC/AHA seem to be making a distinction between those already engaged in strenuous physical activity (conditioning), and those **beginning** a strenuous exercise program. The USPSTF indicates that evidence is insufficient 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."⁷

The Department did not require periodic medical evaluations. NFPA recommends a yearly physical evaluation to include a medical history, height, weight, blood pressure, and visual acuity test.³ NFPA recommends a thorough evaluation to include vision testing, audiometry, pulmonary function testing, a complete blood count, urinalysis, and biochemical (blood) test battery be conducted on a periodic basis according to the age of the fire fighter (less than 30, every 3 years; 30 to 39, every 2 years; over 40 years, every year).

Following the NFPA screening protocol would probably not have identified this individual's cardiomyopathy. This diagnosis is typically made by an echo cardiogram which is not required as part of the NFPA protocol.

RECOMMENDATIONS AND DISCUSSION

The following recommendations address health and safety generally. It is unlikely, however, that any of these recommendations could have prevented the sudden cardiac arrest and subsequent death of this Driver/Operator. 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 research presented in the literature or consensus votes of Technical Committees of the National Fire Protection Association or labor/management groups within the fire service. In addition, they are presented in a logical programmatic order and are not listed in a priority manner.

Recommendation #1: Fire fighters should have mandatory annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.



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Guidance regarding the content and frequency of periodic medical evaluations for fire fighters can be found in NFPA 1582, Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians,³ and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) wellness/fitness initiative.⁸

Recommendation #2: Exercise stress tests should be incorporated into the Fire Department's medical evaluation program.

NFPA 1582, Standard on Medical Requirements for Fire Fighters, and the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) wellness/fitness initiative both recommend at least biannual EST for fire fighters.^{3,8} They recommend that these tests begin at age 35 for those with CAD risk factors and at age 40 for those without CAD risk factors. The EST could be conducted by the fire fighter's personal physician or the City's contract physician. If the fire fighter's personal physician conducts the test, the results must be communicated to the City contract physician, who should be responsible for decisions regarding medical clearance for fire-fighter duties.

Recommendation #3: Phase in a mandatory wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.

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.⁹ In 1997, the International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) joined in 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.⁸ 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.

Recommendation #4. Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatus (SCBA).

OSHA's revised respiratory protection standard requires employers to provide medical evaluations and clearance for employees using respiratory protection.¹⁰ These clearance evaluations are required for private-industry employees and public employees in States operating OSHA-approved State plans. Indiana is a State-plan State; therefore, public employees are required to comply with OSHA standards. A copy of the OSHA medical checklist has been provided to the Fire Department and should not involve a financial burden to the Fire Department beyond that already required for the preemployment, biannual, or annual medical evaluation.

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INVESTIGATOR INFORMATION

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