



## Fire Fighter Dies at House Fire - New Hampshire

### SUMMARY

On December 23, 2000, a 43-year-old male fire fighter complained that it was too hot while performing a primary search on the second (fire) floor of a house. After exiting the structure, he briefly leaned against the back of a ladder truck and then collapsed. CPR was initiated immediately, but on-scene and hospital resuscitation efforts were unsuccessful. Atherosclerotic and hypertensive cardiovascular disease and pulmonary emphysema were found on autopsy. The death certificate listed cardiac arrhythmia as the cause of death.

Other agencies have proposed a three-pronged strategy for reducing the risk of on-duty heart attacks and cardiac arrests among fire fighters. This strategy comprises (1) decreasing physical stress on fire fighters, (2) identifying and modifying cardiac risk factors in fire fighters, and (3) improving job-related physical fitness. Issues relevant to this Fire Department include the following:

- *Fitness and wellness programs aimed at modification of cardiac risk factors*
- *Implementation of National Fire Protection Association (NFPA) 1582 Standard on Medical Requirements for Fire Fighters and Information for Physicians*
- *Implementation of NFPA 1500 Standard on Occupational Safety Programs for Fire Departments*
- *Implementation of NFPA 1710 Standard on Fire Department Staffing and Deployment*

### INTRODUCTION AND METHODS

On December 23, 2000, a 43-year-old male fire fighter collapsed after leaving a house fire where he was performing active fire suppression. Despite CPR and advanced life support (ALS) administered by crew members and the hospital medical personnel at the emergency department, the victim died. National Institute for Occupational Safety and Health (NIOSH) was notified of this fatality on December 26, 2000, by the United States Fire Administration. On June 15, 2001, NIOSH contract investigators contacted the affected fire department to initiate the investigation. On September 17, 2001, the investigators traveled to New Hampshire to conduct an on-site review of the incident.

The investigators met with and interviewed the following:

- Crew members at the scene of the fire call
- On-scene ambulance service personnel
- Fire chief, district chiefs, and the incident commander
- Union representatives
- Representatives from the State Fire Marshal's office
- Victim's wife

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](http://www.cdc.gov/niosh/firehome.html)  
or call toll free **1-800-35-NIOSH**



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During the site visit investigators reviewed the following:

- Autopsy, death certificate
- Ambulance report
- Fire Department physical fitness requirements, physical exam protocols
- Fire Department risk management report prepared by outside contractors
- Fire Department medical file
- Fire Department training records
- Fire Department policies and operating guidelines
- Past medical records of the deceased
- Incident reports (National Fire Incidence Reporting System [NFIRS], District Chief [DC], various officers)
- Audiotape of incident radio communications with dispatch
- Federal Emergency Management Agency (FEMA) report of this incident
- State Fire Marshal's report of this incident
- NFPA 2000 Survey of Fire Departments

**INVESTIGATIVE RESULTS**

*Incident.* On December 23, 2000, at 0732 hours, a 911 call reported heavy smoke in the first floor of a residential building. The fire origin was later found to be an overloaded electrical cord between the second and third (attic) floors of the three-family house. A first-alarm assignment was dispatched, and an oncoming chief en route from his home to Fire Headquarters for his regular shift (DC-1) simultaneously noted smoke in the area of call origin. Three engines (E-1 with three fire fighters, E-2 with four fire fighters, and E-3 with three fire fighters), two ladder trucks (T-1 with three fire fighters and T-2 with two fire fighters), and a heavy rescue (R-1 with four fire fighters) responded. On the scene by 0734 hours, DC-1 conducted initial size-up and noted smoke and fire showing on the second floor of a 2 ½-story wood building. Bystanders reported people trapped inside, and DC-1 immediately requested two additional engines (E-4 with six fire fighters and T-3 with two fire fighters). The first-

alarm assignment arrived on the scene between 0735 hours and 0740 hours, and the second-alarm assignment, consisting of ALS2 (EMT-P and EMT-I), E-5 (three fire fighters), and E-6 (four fire fighters) as the Firefighter Accountability and Search Team (FAST), was dispatched by 0737 hours. The call came in at shift change; therefore, more personnel than usual responded.

E-2 arrived first on the scene at 0735 hours and noted heavy fire from second-floor windows which blew out both front and side windows. A live electrical wire hung down from the roof on the same side of the house. The victim, another fire fighter, and a Lieutenant in full protective gear and SCBA advanced a charged 1 ¾-inch hoseline inside and up the stairs. The victim handed up hoseline from the stairs while the Lieutenant and fire fighter performed search and rescue for two children who were known to be in the house. Thick, black smoke banked to the floor and high temperatures were present as the Lieutenant tried one door directly in front of him. Thinking it was a closet door (because it opened out), he and the fire fighter quickly tried and forced a door to the right, hearing muffled voices inside. Light smoke was present, and the voices were from two working R-1 fire fighters who were also performing search and rescue. They had entered from the rear of the house while two other R-1 fire fighters had entered from the front. The Lieutenant and fire fighter opened the first door again, directing their attention to the fire apartment. Upon making access through the door, they noted the thick, black smoke and high heat that changed into "orange fire that just went right through" them, which seemed like a "rollover." They quickly found one civilian victim approximately 8 feet from the top of the stairs. After extinguishing his clothing, they brought him down the stairs to the outside of the house.

The victim was at that time standing on the stairs off to one side. The time was approximately 0738 hours.



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Two R-1 fire fighters that had entered from the front of the house ascended the stairs after the first civilian victim was brought out, and they quickly found a second civilian victim. The Lieutenant and fire fighter from E-2 returned to help an R-1 fire fighter (who had entered via the rear) bring the second civilian victim down to the first floor. The other R-1 fire fighter and the victim from E-2 stayed together on the second floor and continued to search. As they moved objects out of the way, they noted intense heat and flashes. The victim backed out, stating it was too hot and he had to catch his breath. He stood up, leaned on a bureau, and coughed while the other kept searching. The victim denied needing anything when asked. The R-1 fire fighter watched him descend the stairs. Upon his exit, DC-1 asked him how the fire was; he stated it was pretty much knocked down.

The victim went to the rear of the apparatus parked directly in front of the house, and at 0749 hours, another fire fighter walked by him to obtain a ladder. The victim's facial color was variably described as purple or bright red, and he was asked by other fire fighters if he was okay. As no safety officer was present at the scene, one fire fighter then expressed his concern about the fire fighter to an off-duty DC. The victim leaned against the apparatus briefly, and he had a witnessed collapse at 0750 hours, falling on his back with self-contained breathing apparatus (SCBA) still in place. Immediately he was surrounded by fire fighters who removed his personal protective equipment (PPE) and SCBA. He was pulseless and took a couple breaths. His helmet had fallen off and his clothes were soaking wet. His low-air alarm was not sounding, and his PASS alarm had not activated by the time fire fighters arrived at his side. A precordial thump was given and CPR was administered, and as he was carried on a backboard to the ambulance a short distance away, the EMT-I used a bag-valve-mask for ventilation. He was noted to be in ventricular fibrillation on the monitor, was defibrillated, and then converted to asystole (no heart

rhythm). Further resuscitation efforts, including intubation and ACLS, continued but ultimately failed in the emergency department, where he was pronounced dead.

Medical Findings. The victim had the following known risk factors for coronary artery disease (CAD): a family history of CAD (father died of myocardial infarction at age 42; other close relatives also died of CAD), cigarette smoking, and high blood pressure (hypertension). In addition, he had recent and significant cardiac history. Available medical records noted hypertension diagnosed in 1994, and he had been treated with prescription anti-hypertensive medication since 1995. Compliance with the regimen is unknown, as his spouse remembers him on no medications before 1999. Subjective "chest pain" was noted several times in 1994-1995 medical records.

In November 1999, the victim developed chest and left shoulder pain while at rest, and he was diagnosed with an inferior wall myocardial infarction by electrocardiogram (EKG) changes and cardiac enzyme elevation. He was treated with thrombolytics (blood clot dissolvers). Cardiac catheterization during that hospitalization demonstrated CAD, with significant single artery narrowing, that improved after intravenous nitroglycerin. His CAD was considered noncritical. Two weeks after discharge, he was evaluated with an exercise stress test (EST) which showed "indeterminate ischemic EKG changes"; the victim reached satisfactory workload (13 METS, or metabolic equivalents) during this test.

In February 2000, the victim developed chest pain and shortness of breath while removing a ladder from fire apparatus. EMS brought him to an emergency department, and he underwent another EST the following day. He exercised to 10 METS and had nondiagnostic EKG changes. This was considered a negative EST, which was communicated to the fire department, and he resumed work as a fire fighter.



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There were no more visits to his cardiologist. Coworkers noted that the victim did not perform optional physical exercise and that he used sublingual nitroglycerin on occasion. He did not display any signs or symptoms of discomfort, nor was he seen to take any medications such as nitroglycerin the morning of his death.

An autopsy revealed a nontoxic carbon monoxide level, detectable blood ethyl alcohol, pulmonary emphysema, and atherosclerosis of the coronary arteries. Specifically, the artery supplying the anterior wall of the heart was focally occluded, and two other major arteries were 40-50% occluded. No acute thrombi (blood clots) were noted. The death certificate listed “(a) atherosclerotic and hypertensive cardiovascular disease with cardiac arrhythmia following (b) stress and exertion during firefighting” as the cause of death.

**DESCRIPTION OF THE FIRE  
DEPARTMENT**

At the time of the NIOSH investigation, the Fire Department consisted of 223 active career personnel and served a population of 102,000 in 34 square miles. The department has nine fire stations which are covered by 17 companies. The rescue company is a component of the fire department and all fire fighters are EMT-Bs; however, a separate organization covers EMS.

Fire fighters work 10-hour days (D) and 14-hour nights (N) on the following schedule: D, N, D, day off, D, N, followed by 3 days off. In 2000, the fire department responded to 12,815 calls: 475 fire calls (170 structure fires, 104 vehicle fires, 55 rubbish fires, 107 brush fires, and 39 other fires), 8362 rescue calls, 315 hazardous-condition calls, 1852 false alarms, and 1811 other calls. The victim had not responded to other calls during the 24-hours before or during the shift on which he died. The fire call occurred at shift change; therefore, the victim had just begun his 10-hour shift.

*Training.* The Fire Department requires that all new fire fighter applicants pass a written examination, oral interview, and a series of physical ability tests. Plans are in place to change to Candidate Physical Ability Testing (CPAT) in the near future.<sup>1</sup> Newly hired fire fighters must be certified in Fire Fighter II, Hazardous Materials (HazMat) Operations, EMT-B, and they must complete Recruit School (12 weeks). Ongoing training is provided throughout the year; however, no annual minimum requirement exists. Approximately two-thirds are certified as HazMat Technicians. The victim was certified as a Fire Fighter I, EMT-B, Hazmat Operations, and he had 15 years of fire-fighting experience.

*Preemployment/Preplacement Evaluations.* The Fire Department requires a preemployment/preplacement medical evaluation for all new hires regardless of age. This evaluation in standard practice parallels HazMat clearance, and components of this exam include the following:

- Blood tests including complete blood count, electrolytes, liver function tests
- Urinalysis, heavy metal exposure screen
- Physical exam
- PPD - (tuberculosis test)
- Pulmonary function testing (evaluation for respirator wear)
- Chest X-ray every 3 years
- Electrocardiogram

*Periodic Evaluations.* The same medical evaluation is required of all HazMat Technicians within the department (approximately two-thirds of fire fighters) annually; however, the Department does not require medical evaluation or respirator clearance for those fire fighters who are not also HazMat Technicians and does not require physical agility/fitness testing for incumbent fire fighters.

The victim’s last Fire Department medical evaluation as a HazMat technician was in 1994, and his medical clearance for that function was withdrawn because



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of abnormal PFT results. No further fitness-for-duty medical examination was pursued, and he continued to work as an internal structural fire fighter. Fire Department Standard Operating Procedures for the wearing of SCBAs does not mention medical clearance. Fire Department policy requires that an employee who is injured or ill for more than 3 days must be evaluated and cleared for return to work by a physician. There are no policies dealing with specific expertise of physicians performing this function, and there is no designated fire department physician. Exercise equipment exists in every fire station in the city.

**DISCUSSION**

In the United States, coronary artery disease (atherosclerosis) is the most common risk factor for cardiac arrest and sudden cardiac death.<sup>2</sup> 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.<sup>3,4</sup> The victim had several risk factors for coronary artery disease (male gender, smoking, family history, high blood pressure, and physical inactivity), and he had evidence of CAD on two ESTs during the year before his death.

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.<sup>2</sup> However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.<sup>5</sup> 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.<sup>6</sup> This sudden blockage is primarily due to blood clots (thrombosis) forming on top of atherosclerotic plaques. On the victim's autopsy, no acute thrombotic lesions were seen, but his left anterior descending artery was focally occluded.

Blood clots, or thrombus formation, in coronary arteries are initiated by disruption of atherosclerotic plaques. Certain characteristics of the plaques (size, composition of the cap and core, presence of a local inflammatory process) predispose the plaque to disruption.<sup>6</sup> Disruption then occurs from biomechanical and hemodynamic forces, such as increased blood pressure, increased heart rate, increased catecholamines, and shear forces, which occur during heavy exercise.<sup>7,8</sup>

Fire fighting is widely acknowledged to be one of the most physically demanding and hazardous of all civilian occupations.<sup>9</sup> Fire-fighting 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.<sup>10-12</sup> Even when energy costs are moderate (as measured by oxygen consumption) and work is performed in a thermo-neutral environment, heart rates may be high (over 170 beats per minute) owing to the insulative properties of the personal protective clothing.<sup>13</sup> Furthermore, fire fighting can result in severe fluid loss which decreases blood volume and decreases the amount of blood pumped from the heart (stroke volume).<sup>14</sup> Epidemiologic studies have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.<sup>15-18</sup> The victim responded to an early morning alarm, was in full bunker gear, and conducted strenuous work while in a high-heat environment. Had extra personnel not been present, he easily may have been inside the structure at the time of collapse, further endangering rescue personnel or delaying the discovery of his collapse. The stress of responding to this fire and his underlying atherosclerotic CAD both contributed to this fire fighter's probable heart attack, arrhythmia, subsequent cardiac arrest, and sudden cardiac death.



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The NFPA has developed and revised guidelines for Fire Department physicians entitled *Medical Requirements for Fire Fighters and Information for Fire Department Physicians*, also known as Standard 1582.<sup>19</sup> Included are appendices with further information, which, among other things, are aimed at reducing the risk of cardiovascular disease and deaths within the fire service. NFPA 1582 recommends a baseline EKG and screening for CAD risk factors. NFPA 1582 also recommends an EST at age 40, and at age 35 for those with one or more CAD risk factors, with repeat testing every 2 years. The 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). These recommendations are similar to those of the American College of Cardiology/American Heart Association.<sup>20</sup>

The NFPA recommends a yearly physical evaluation to include a medical history, height, weight, blood pressure, and visual acuity test, with a more thorough evaluation periodically according to the fire fighter's age (less than 30 years, every 3 years; 30-39 years, every 2 years; greater than 40 years, every year). This exam includes vision testing, audiometry, pulmonary function testing, a complete blood count, electrolyte blood testing, and urinalysis. This Fire Department did not require comprehensive annual medical exams of fire fighters who had been on the job for more than 4 years, or exercise stress testing.

NFPA 1582 categorizes fire fighters' medical conditions as Category A (precludes a person from performing as a fire fighter) and Category B (*could* preclude). CAD, including history of myocardial infarction, coronary artery bypass surgery, or coronary angioplasty, is a category B condition, but Appendix A contains additional guidelines. "Persons at mildly increased risk for sudden incapacitation are

acceptable for fire fighting. Mildly increased risk is defined by the presence of each of the following:

- Normal left ventricular ejection fraction
- Normal exercise tolerance, >10 metabolic equivalents (METS)
- Absence of exercise-induced ischemia by exercise testing
- Absence of exercise-induced complex ventricular arrhythmias
- Absence of hemodynamically significant stenosis on all major coronary arteries (>=50% lumen diameter narrowing)".<sup>19</sup>

Based on this fire fighter's second EST, he did not appear to meet the second, third and fifth criteria and should have been restricted from fire-fighting duties pending further evaluation and treatment of his CAD.

### **RECOMMENDATIONS**

The following recommendations address health and safety generally. The list includes some preventive measures that have been recommended by other agencies to reduce the risk of line-of-duty cardiovascular events including sudden cardiac death among fire fighters. These recommendations have not been evaluated by NIOSH, but they represent published research or consensus standards developed by the NFPA or other technical working groups within the fire service.

*Recommendation #1: Phase in a mandatory fitness/wellness program for fire fighters to modify cardiac and other personal risk factors for adverse outcomes on the fireground.*

The IAFF/IAFC Labor-Management Fitness and Wellness Initiative<sup>1</sup> and NFPA 1583 *Standard on Fire Department Health-Related Fitness Programs for Fire Departments*<sup>21</sup> both provide templates for mandatory fire fighter participation in nonpunitive risk-reduction strategies. Neither of these



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includes a physical performance test, and no job-specific physical performance test or fitness standard has been validated for incumbent fire fighters to date. Both encourage individualization of exercise regimens and other wellness interventions. In these programs, “nonpunitive” refers to the absence of a uniform physical performance standard, and not to voluntary participation by fire fighters. Such programs, though not designed to remove suboptimally performing fire fighters from the line, have been shown to reduce employee sick time utilization and compensation claims.<sup>22,23</sup>

Fitness-wellness programs for fire fighters also address cardiac risk factors such as diet and smoking. Cigarette smoking is thought to represent the greatest modifiable risk factor for coronary artery disease and should clearly be a major target of fire service wellness programs.

Additionally, it is critical that issues related to substance abuse be addressed by employee assistance programs and/or fitness wellness programs in fire departments. The presence of a detectable alcohol level at autopsy indicates that the victim had a decreased physiologic ability to tolerate the demands of fire fighting on the day of his death. This is because the innate dehydration associated with alcohol in the bloodstream compromises cardiac stroke volume, which normally decreases rapidly during fire-fighting operations in the heat.<sup>14</sup>

*Recommendation #2: Fully implement NFPA 1582 Standard on Medical Requirements for Fire Fighters and Information for Physicians as well as annual medical exams for all fire fighters.*

This department has initiated yearly medical exams for all fire fighters hired in the past 4 years, and it requires annual OSHA-compliant medical exams for all Hazmat team members (cumulatively about two-thirds of the department). Full implementation of NFPA 1582 would serve several relevant purposes

in this department. First, it would ensure that at least one physician (the Fire Department Physician) is familiar with the physical demands of fire fighting when medical fitness for duty is being considered. This can be written into the specifications for providers of occupational medical services to the fire department. Occupational medical services should include not only yearly medical exams but also make determinations regarding fitness for return to duty and coordinate prescriptive rehabilitation programs. These specialized functions should be coordinated with medical subspecialists (e.g., cardiologists) in the community when necessary, but they should not be left solely to fire fighters’ personal physicians, who may have little understanding of the physical demands of the profession.

As stated in NFPA 1582, it is the responsibility of the fire department to supply physicians performing these functions with explicit descriptions of the essential job tasks of that department’s personnel. Cardiologists clearing fire fighters to return to work after a heart attack seldom understand that the job requires wearing 50 pounds of equipment, carrying 75-pound high-rise hose packs up multiple flights of stairs, and then performing heavy upper body exertion while using a demand-type respirator in temperatures that can exceed 700 degrees Fahrenheit.<sup>24</sup> Fewer fire fighters with “borderline” cardiac angiograms, equivocal stress tests, and unmodified risk factors would be on the line if physicians were clearing for specific job tasks as opposed to signing back-to-work slips.

OSHA-compliant pulmonary function testing is also required by NFPA 1582. Fire fighters who cannot safely perform heavy work while wearing SCBA would be medically disqualified.<sup>25</sup> This fire fighter had been relieved of Hazmat duties because of abnormal pulmonary function test results 6 years earlier, but he continued as an interior structural fire fighter until his death. It is unknown whether compromised pulmonary status contributed in any



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way to this fire fighter's cardiovascular collapse. In general, however, both exercise capacity and oxygen delivery to essential organs are reduced when pulmonary function is not adequate.

NFPA 1582 requires rigorous cardiovascular and work capacity testing of fire fighters with known heart disease or significant cardiac risk factors. After his heart attack and a subsequent hospital emergency department visit for chest pain that was followed up by an outpatient exercise stress test, he was cleared to return to duty by a cardiologist. This physician acknowledged the victim's coronary heart disease and less than perfectly normal test results, but quite reasonably elected to manage his disease medically rather than surgically, and felt that he was not an immediate risk for major heart attack. On this basis, he was cleared for duty. The cardiologist was not aware of NFPA 1582 or what cardiac workup was recommended by the technical committee before medically clearing a fire fighter to return to duty with coronary heart disease. He had also not been made aware of the true demands of the job by the fire department as required by NFPA 1582. This common oversight can easily be addressed by preparing a representative list of the physically demanding essential job tasks that departmental fire fighters are required to perform in the line of duty. The fire department should consider "Essential Structural Fire-Fighting Functions" (Appendix C) of 1582 while creating their list.<sup>19</sup> These compiled descriptions can then serve as a checklist that can be used by physicians clearing fire fighters to return to duty. In other words, the physician would be asked to check off each task that, in his or her opinion, the fire fighter can safely perform in his or her current medical condition. The Department's "Risk Management Plan" prepared in May of 2000 stressed implementing 1582, specifically mentioning the Fire Department's necessary involvement.

*Recommendation #3: Enhance training and adherence to Department S tandard Operating Procedures (S OPs) related to safety during interior structure operations.*

A. FD Risk Management Plan

This incident was a (generally) well-run and effective rescue/suppression operation. Two civilian victims had been found, carried out, and handed over to EMS teams outside, and the fire had been knocked down within 10 minutes of fire apparatus arrival. Although they did not appear to impact outcomes at this particular operation, a number of potentially significant departures from NFPA 1500, *S tandard on Fire Department Occupational S afety* were noted.<sup>26</sup> Specifically, fire department officers and personnel did not follow their own published, NFPA-compliant SOPs. At the time of the NIOSH investigation, a sampling of fire fighters who responded to this incident were unable to cite department policy as set forth in some of these crucial SOPs. Areas of particular concern are the department's accountability system, the configuration of company activation associated with alarms, and staffing of Incident Command System (ICS) positions on the scene: all are also mentioned in the Department's Risk Management Plan. The Incident Scene component of the Plan rates fireground accountability (including arrival of off-duty personnel) with high priority and of high frequency and severity. In addition, advantages of automatic (and earlier) dispatch of the department's FAST engine were discussed in the plan.

B. Rehabilitation and Medical Monitoring

The victim was working as part of a two-man team performing a primary search of a super-heated, second-floor room that had recently flashed or rolled over, according to other crew members present. He complained that it was too hot and he needed to



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leave. His partner observed him leaning against a piece of furniture, coughing. His partner asked whether he could wait while he finished his search, which he did while remaining in visual contact. The victim said he was okay, he just needed to get out and rest. After completing his search of the room, his partner accompanied the victim to the head of the stairs, then watched him descend and exit the front door of the residence. His partner then paired up with another fire fighter on the second floor and continued interior operations. Although the victim spoke briefly to the IC regarding interior conditions on his way down the front walk, no one outside was aware that he had been forced from the interior by medical symptoms. He was therefore not referred to EMS, which was on the scene, for evaluation or treatment until after his witnessed collapse. The victim's collapse occurred early in operations; however, there were no provisions for an on-scene rehabilitation area for fire fighters, staffed by medical personnel, as required by NFPA 1500.<sup>26</sup>

#### C. Crew Integrity and Accountability

It is unlikely that earlier recognition of the severity of his condition would have changed the outcome in this case. Adherence to standards of accountability and crew integrity should be emphasized here, however, as it could save future lives under similar circumstances. Crews should remain together during interior operations at structure fires. Any member of a working crew complaining of medical symptoms or inability to continue working should cause the crew to exit the structure as a unit.<sup>27</sup> The incapacitated fire fighter should be delivered to a rehab or medical area for rest and evaluation. Before reentering the structure, the appropriate sector or command officer, along with the accountability officer, should be advised of the change in crew staffing. Otherwise, accountability systems become ineffective, since boards designed to track staffing and location of crews do not reflect either one.

An accountability system is outlined in this department's SOPs, but it is not used consistently or in a consistent manner by the officers who assume command at structure fires. The problem was exacerbated by the fact that this incident occurred during change of shift, so some accountability tags had not been added or removed from the apparatus by the various crew members. Some grabbed their gear and jumped on apparatus to which they were not regularly assigned to assist in the response. Few systems are designed to handle such circumstances, though they are probably not rare in fire service responses. Personal involvement by an accountability officer on the scene would probably be necessary to overcome the shortcomings of automatic systems under these circumstances.

#### D. Staffing and Deployment

Staffing was better than is usually available because members of both the off-going and oncoming shifts were on hand at the time of the alarm. Personnel who were interviewed indicated that there was confusion regarding the companies dispatched to the incident. This apparently resulted from the IC's decision to cancel the engine company that would normally have served as the FAST backing up the interior suppression crews and to request one that was substantially further away but reportedly staffed with a four-man crew. NFPA 1710 (in draft form at the time of the incident) delineates the personnel and functions that are required to safely initiate interior structural fire-fighting operation.<sup>28</sup> It is recommended that the response configurations to various levels of alarm reflect this standard to ensure the earliest possible arrival of all essential assets on the scene.

EMS personnel interviewed during the investigation expressed concern over the fact that their staff had been led inside the structure by fire fighters to evaluate one of the civilian victims. The interior was still full of dense smoke in which the EMTs could not breathe,



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and the fire on the upper floors was not yet under control. While no obvious adverse outcome was associated with this lapse in protocol, it raises the issue of the need to staff the on-scene safety officer position. This is required by NFPA 1561 and by the Fire Department's own SOP, which states that a second alarm (or greater) fire mandates the assignment of a safety officer.<sup>29</sup>

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**INVESTIGATOR INFORMATION**

This investigation was conducted by and the report written by Carin Van Gelder, MD, and Sandy Bogucki, MD, PhD. Drs. Van Gelder and Bogucki conducted this investigation under contract with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component, located in Cincinnati, Ohio.



*Fire Fighter Dies at House Fire - New Hampshire*



*Photo 1. Heavy smoke and fire envelops an occupied residential structure.*