

**U.S. FIREFIGHTER FATALTIES
DUE TO SUDDEN CARDIAC DEATH, 1995 - 2004**

**Rita F. Fahy
Fire Analysis and Research Division
National Fire Protection Association**

June 2005



For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7450.

Copies of this report are available from:

National Fire Protection Association
One-Stop Data Shop
1 Batterymarch Park
Quincy, MA 02169-7471
www.nfpa.org
e-mail: osds@nfpa.org
phone: 617-984-7450

Copyright © 2005, National Fire Protection Association, Quincy, MA

U.S. Firefighter Fatalities Due to Sudden Cardiac Death – 1995 - 2004

Sudden Cardiac Death is defined by the American Heart Association on their website as "the sudden, abrupt loss of heart function in a person who may or may not have diagnosed heart disease." The website (www.americanheart.org) goes on to say, "Sudden cardiac death is a major health problem, causing about 340,000 deaths each year among U.S. adults." For the first time in this NFPA study of on-duty firefighter deaths, we are using the term 'sudden cardiac death' as an umbrella term to include heart attacks as well as other heart-related deaths. This 10-year analysis does not include strokes (CVA) or aneurysms, though they also involve the cardiovascular system.

Of the 1,006 on-duty firefighter fatalities over the 10-year period, 440 (43.7 percent) fell into the category -- sudden cardiac death. (Over the same period, there were also 15 deaths due to strokes and eight due to aneurysms.) The aspects of the problem examined in this study include the victims' demographics, medical histories and work circumstances.

Over the 10-year period, the annual number of sudden cardiac deaths has ranged from a high of 51 in 1999 to its lowest level of 37 in 2002. As reported earlier, there were 48 such deaths in 2004. Looking back to 1977, when NFPA first began this annual study of firefighter fatalities, we find a much higher number of deaths each year -- an average of 60 deaths a year from 1977 through 1986 (Figure 1). The number of sudden cardiac deaths annually has fallen by approximately one third from the late 1970s to the most recent three-year period. However, since the early 1990s, the number of deaths each year has tended to fluctuate between 40 and 50.

Medical History

Autopsies or post mortem information (such as death certificates) are sought for all reported firefighter fatalities. In some cases, information widely known to the fire department (such as prior heart attacks or heart surgery) is mentioned on the reporting

forms. Such information was available for 308 of the 440 victims of sudden cardiac death. Of these 308 firefighters, 134 (43.5 percent) had prior known heart-related conditions, such as previous heart attacks or had undergone bypass surgery or angioplasty/stent placement.

Another 97 of the victims (31.5 percent) had arteriosclerotic heart disease, defined as arterial occlusion of at least 50 percent. This is a detectable condition, but the victims may not have been tested, and may never have been aware of their condition.

Type of Duty

The largest proportion of the victims experienced cardiac symptoms during fire ground operations (155 deaths or 35.2 percent). Only three of those 155 deaths were reportedly due to exposure to smoke. One of the three smoke-exposure deaths occurred at a wildland fire, where firefighters do not use self-contained breathing apparatus (SCBA). The other two deaths were at structure fires. One of the victims was reported to have been using SCBA while stretching the hoseline to reach a basement fire, and his facepiece may have been dislodged while he was being rescued. His COHb level was approximately 16%, and he had a prior history of cardiomegaly and mild arteriosclerosis. The other victim was directing interior extinguishment operations and overhaul and did not wear his SCBA at any time during the fire. His COHb level was at least 35% and according to the autopsy report he had suffered a heart attack months to years earlier.

The next largest proportion involved firefighters responding to or returning from alarms (111 deaths or 25.2 percent). Of these 111 firefighters, 52 were responding to incidents and 59 were returning or had returned from the alarm when they were stricken. Most of the alarms that resulted in these deaths involved actual emergencies, but there were 14 false calls involved -- three of them malicious false alarms. In its investigations of on-duty cardiac-related fatalities, NIOSH reports " Firefighting activities are strenuous and often require firefighters 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 to persist through the course of fire suppression activities."*

The other major types of duty included training, which accounted for 50 deaths (11.4 percent), non-fire incidents such as emergency medical and rescue calls, which accounted for 47 deaths (10.7 percent), and administrative and normal station duties, which accounted for 46 deaths (10.5 percent). The other 31 fatalities (7.0 percent) occurred during other on-duty activities such as fire prevention, inspection, maintenance, etc. Of the 50 firefighters who died during training activities, 21 were engaged in physical fitness activities, such as jogging, playing basketball or undergoing endurance or agility tests; 21 were involved in emergency operations training evolutions, including smoke drills, live fire training, search and rescue drills, etc.; and six were in meetings or classroom settings. Specific details of the training were not available for two of the victims.

NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments, identifies a category of existing medical conditions "that would preclude a person from performing as a member in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others." Among many others, these conditions include coronary artery disease, history of myocardial infarction, coronary artery bypass surgery, coronary angioplasty, cardiomyopathy, myocarditis, etc. This provision applies to candidate firefighters.

For those who are already members of fire departments, the standard requires an annual medical evaluation and an annual occupational fitness evaluation for all members of a fire department. If, as a result of these annual evaluations, or following occupational exposure, illness, injury, or protracted absence from the job, evidence surfaces that the

* See, for example, "Report Number FACE-F2004-46, Fire fighter collapses and dies while assisting with fire suppression efforts at a residential fire," <http://www.cdc.gov/niosh/face200446.html> The NIOSH studies cite Barnard RJ, Duncan HW [1975]. Heart rate and ECG responses of fire fighters. *J Occup Med* 17:247-250.

member has a specific medical condition, the standard requires an individual evaluation by the fire department physician of that member's ability to perform the essential job tasks as defined by the standard, and validated by the fire department. With relation to cardiovascular disorders, the standard cites several essential job tasks as relevant. All are relevant to determining that a firefighter can continue to function as an integral component of a team, where sudden incapacitation of a member can result in mission failure, or in risk of injury or death to civilians or other team members. These include performing firefighting tasks, rescue operations and other emergency response actions under stressful conditions while wearing personal protective equipment and SCBA; wearing SCBA which requires the ability to tolerate increased respiratory workloads; climbing stairs in full turnout gear while carrying tools and equipment; wearing an encapsulating and insulated fire protective ensemble; rescue-dragging or carrying victims; advancing hoselines; and experiencing prolonged periods of extreme physical exertion without benefit of warm-up, rest, or hydration.

If the provisions of *NFPA 1582* were followed, we would expect to find, among the firefighters who died at the fire ground, at other emergency calls or while responding to or returning from alarms, few if any who had had previous heart attacks or undergone bypass surgery or angioplasty/stent placement. We would expect that those people would have been reassigned away from emergency operational environments.

To check this hypothesis, we looked again at the sudden cardiac deaths among on-duty firefighters from 1995 through 2004, and considered only those 134 who reportedly had prior heart attacks or bypass surgery. We found that 50 were working on the fireground. Another 31 were responding to or returning from alarms and 13 were operating at non-fire emergencies. Clearly, the provisions of *NFPA 1582* are not being followed.

Eighteen others were involved in training activities. Training is another category of duty from which firefighters with known heart problems can be reassigned, but this

category can also include fire department instructors, or firefighters engaged in fitness activities; in neither case would others have been put in jeopardy and so this category of type of duty was not included in testing the hypothesis. The remaining 22 victims with known prior heart problems were involved in other fire department activities, such as maintenance, inspections, working around the station, etc.

Other Characteristics

The victims of sudden cardiac death from 1995 through 2004 ranged in age from 17 through 81, with a median age of 52 years (Figure 2). Three of the four victims under the age of 25 were reported to have existing heart problems, including one with cardiomegaly and another who had had a heart valve replacement.

Of the 440 victims of sudden cardiac death from 1995 through 2004, 307 were volunteer firefighters, 117 were career firefighters, eight were employees of state wildland management agencies, four were employees of or contractors with federal wildland management agencies, two were in or employed by the military, one was a prison inmate working on a wildland firefighting crew and one was an member of an industrial fire department.

Ninety-three percent of the firefighters aged 60 and over who were victims of sudden cardiac death were volunteer firefighters, and all but one of the firefighters aged 65 or over was a volunteer. This probably reflects the tendency of volunteer firefighters to remain active well beyond the retirement ages of career firefighters. Twenty-four of the victims aged 60 and over were acting as fire police at the time of their death.

Figure 3 shows the number of fatalities by career status since 1977. Sudden cardiac deaths among career firefighters decreased over the years until 1993, but the number annually has never been lower than it was that year (nine deaths). Cardiac deaths among volunteer firefighters generally has been decreasing since 1988, but the number of deaths continues to fluctuate between the mid-20s to the mid- to high-30s annually.

Summary

From 1995 through 2004, 440 firefighters, or almost half of the total number of firefighters who died while on duty, fell victim to sudden cardiac death, and close to half of those with documented prior medical conditions had known heart problems.

Two out of five fatalities on the fire ground and while responding to and returning from alarms were due to sudden cardiac death, as were just over 50 percent of the deaths during training activities.

Attention must be focused on the significant problem of fire service personnel who have known or detectable heart problems, yet are allowed to remain active in firefighting. Sudden cardiac death continues to be the leading cause of on-duty firefighter fatalities. Steps to reduce the risk of heart attacks among firefighters must be taken. These include:

- conducting annual medical evaluations;
- screening for coronary artery disease (CAD) risk factors;
- conducting exercise stress tests for those with multiple CAD risk factors; and
- giving appropriate treatment for those risk factors and restrictions for firefighters with positive stress tests.

The risk factors for CAD include diabetes, smoking, high cholesterol, high blood pressure, family history and obesity or physical inactivity.

In a 2001 needs assessment of the U.S. fire service, NFPA found an estimated 73 percent of firefighters worked in fire departments that did not have a program to maintain basic firefighter fitness and health, as required in *NFPA 1500, Standard on Fire Department Occupational Safety and Health Program*. In rural communities (under 2,500 population), where nearly all firefighters are volunteers, 88 percent of firefighters worked in departments without such programs. The on-duty deaths described here are further specific evidence of the urgent need for the steps listed above.

Recognizing the importance of establishing fitness and wellness initiatives in fire departments around the country, the Department of Homeland Security has included among the eligible expenditures under its Assistance to Firefighters Grant Program funding for entry-level and annual physicals and immunization programs, as well as physical fitness equipment, services of consultants, trainers and nutritionists, and incentives for participation in formal fitness and injury prevention programs. It is expected that fitness and wellness programs will continue to be eligible for grants in 2006. (Complete details on the grants program can be found online at <http://www.firegrantsupport.com>.)

Acknowledgements

The author would like to thank Thomas Hales, MD, MPH, of NIOSH, and Carl E. Peterson of NFPA's Public Fire Protection Division for their assistance on this study.

Figure 1
Type of Firefighter Fatalities by Year
1977 - 2004

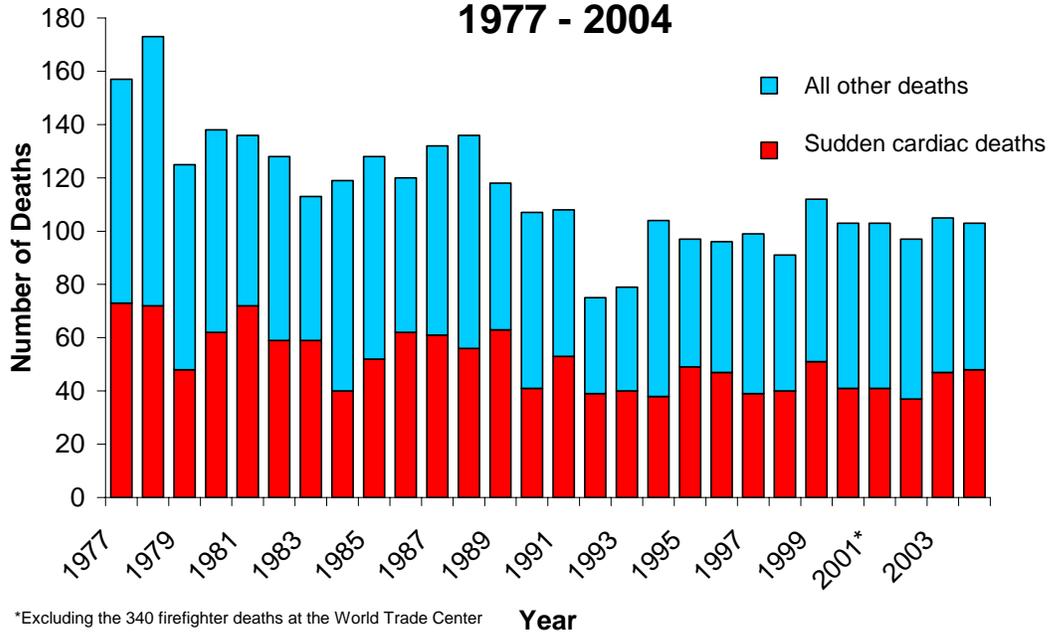


Figure 2
Type of Firefighter Deaths by Age
1995 - 2004

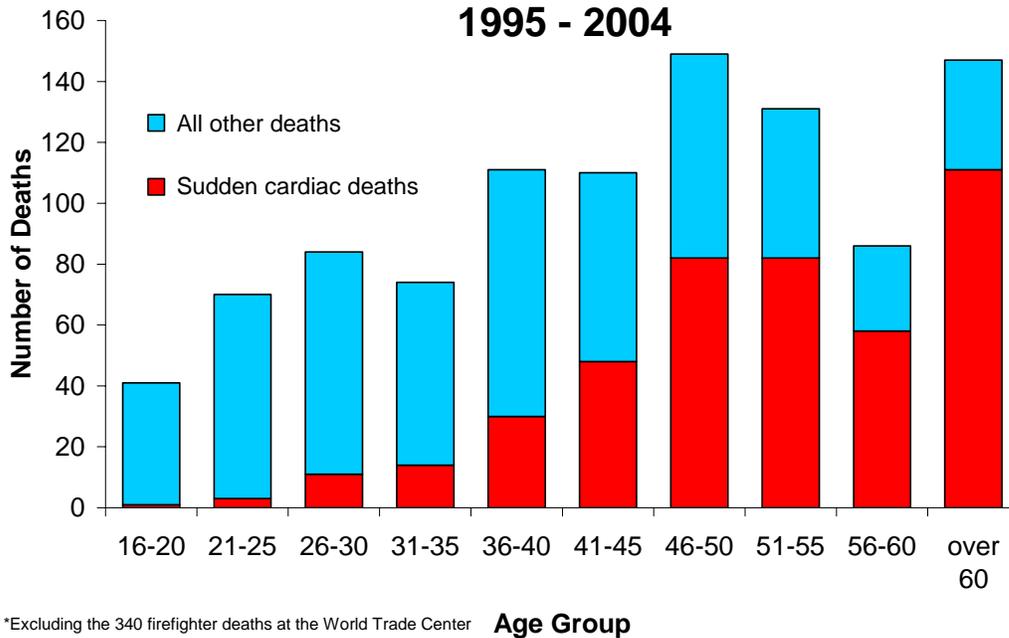
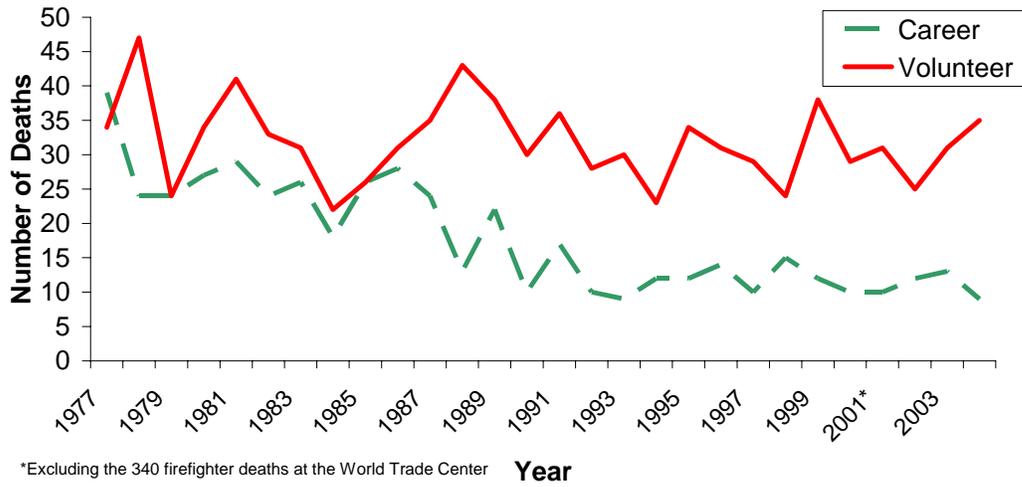


Figure 3
Number of Firefighter Deaths by Career Status
1977 - 2004



*Excluding the 340 firefighter deaths at the World Trade Center