Preventing Occupational Fatalities in Firefighters

By

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PREVENTING OCCUPATIONAL FATALITIES IN FIREFIGHTERS

ABSTRACT

The National Fire Protection Association (NFPA) set one of its goals to reduce firefighter fatalities by 25% in 2005 and by 50% in 2010, but despite advances in technology, the fatality rate has remained relatively unchanged since 1977 (United States Fire Administration [USFA], 2009b). Unfortunately, firefighters continue to die from preventable causes. A review of the literature shows that the leading causes of firefighter fatalities are sudden cardiac death from cardiovascular disease and motor vehicle accidents (MVA). One preventable firefighter fatality is one too many. Many physiological and psychological stressors are present in firefighters’ daily work environments which contribute to sudden cardiac death and motor vehicle fatalities. Health, wellness, and fitness interventions are needed to prevent sudden cardiac death. The occupational and environmental health nurse (OEHN) can help prevent occupational fatalities in firefighters through collaboration with firefighters, fire departments, and local, state, and federal agencies in implementing primary, secondary, and tertiary interventions; conducting health surveillance; providing education, training, and counseling; implementing change; and influencing future policy, practice, and research.
ACKNOWLEDGEMENTS

I dedicate this work to my brother Darrin and the other brave and honorable members of the fire department and emergency services, who selflessly give of themselves to protect others. I can only hope that through this work I am able to make the difference in the life of at least one firefighter. This work is also in memory of those firefighters and their families who gave the ultimate gift and for whom the last fire bell has rung.

I would like to acknowledge my family and friends for their endless support during the long road to earning my MPH; it is a lifelong goal that I never thought possible. A special word of love and appreciation to my husband Derek for his unwavering commitment during my journey, for always being there as my sounding board, for his love and support, and for reminding me that “can’t” was not a word in my vocabulary.

I would also like to acknowledge my academic advisor and first reader, Susan Randolph, MSN, RN, COHN-S, FAAOHN. She has provided guidance, support, words of wisdom, and endless patience during the times when I lacked it. Thank you for all that you have done for me; it has been an honor to learn with you.

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# TABLE OF CONTENTS

Abstract ................................................................................................................................. ii

Acknowledgements ................................................................................................................. iii

Table of Contents ....................................................................................................................... iv

List of Table .............................................................................................................................. vii

List of Figures ............................................................................................................................ viii

Chapters:

1. INTRODUCTION .................................................................................................................. 1

2. LITERATURE REVIEW ......................................................................................................... 4

   Definitions............................................................................................................................... 7

       Firefighters......................................................................................................................... 7

       Line-of-Duty Death........................................................................................................... 9

Demographics ............................................................................................................................ 10

   Age....................................................................................................................................... 10

   Gender................................................................................................................................. 13

Fatality Statistics ...................................................................................................................... 14

   Work-Related Incidence of Firefighter Deaths by Cause of Injury .................................. 14

   Work-Related Incidence of Firefighter Deaths by Nature of Injury ................................. 14

   Incidence of Type of Duty at the Time of Death ............................................................... 17

National Fire Protection Association (NFPA) Standards ...................................................... 17

   NFPA 1500, Fire Department Occupational Safety and Health Program.......................... 18

       Health and Fitness Coordinator (HFC) ......................................................................... 19
NFPA 1582, Comprehensive Occupational Medical Program for Fire Departments ................................................................. 19

Components of Standard 1582 ................................................................................................................................. 20

NFPA 1583, Health-Related Fitness Programs for Firefighters .......................................................... 21

Candidate Physical Ability Test (CPAT) ................................................................. 21

NFPA 1901, Automotive Fire Apparatus ................................................................. 22

Physical Fitness Standards ................................................................................................................................. 23

OSHA Standards ................................................................................................................................................... 25

Partnerships ......................................................................................................................................................... 29

3. TWO LEADING CAUSES OF LINE-OF-DUTY DEATHS (LODD) IN FIREFIGHTERS ................................................................. 31

Cardiovascular Disease ........................................................................................................................................ 31

Sudden Cardiac Death ........................................................................................................................................ 32

Contributing Factors ........................................................................................................................................ 33

Physiological and Psychological Stressors of Firefighting ........................................................................ 33

CHD Risk Factors ............................................................................................................................................. 35

Internal Trauma/Motor Vehicle Accidents ........................................................................................................ 36

Contributing Factors ........................................................................................................................................ 37

Human Factors .................................................................................................................................................. 37

Non-Compliance with Use of ANSI Approved Safety Vests .......................................................... 37

Volunteer Status ............................................................................................................................................ 38

Lack of Seat Belt Use ....................................................................................................................................... 38

Safety Culture ................................................................................................................................................... 41
4. THE ROLE OF THE OCCUPATIONAL AND ENVIRONMENTAL HEALTH NURSE IN THE PREVENTION OF OCCUPATIONAL FATALITIES IN FIREFIGHTERS .................................................................45

Levels of Prevention ..................................................................................47

Primary Prevention .....................................................................................48

Secondary Prevention ..................................................................................49

Tertiary Prevention ......................................................................................50

Education, Training, and Counseling .......................................................50

Nutrition .......................................................................................................51

Designing and Implementing a Fitness Program .......................................52

Site Selection ..............................................................................................52

Incentives ....................................................................................................54

Voluntary versus Mandatory ...................................................................55

Implementing Change ................................................................................55

Theories of Behavior Change ....................................................................56

Barriers to Change ......................................................................................57

Politics and Legislation ..............................................................................57

Legislative Bills ..........................................................................................58

Assistance to Firefighters Grant (AFG) Program ....................................59

Resources and Partners ............................................................................59

5. CONCLUSION/RECOMMENDATIONS ..................................................61

Implications for Future Research, Policy, and Practice ..........................61

REFERENCES ............................................................................................63

APPENDICES ..............................................................................................69
LIST OF TABLE

2.1 Firefighter Causalities in the United States (1999-2008) ............................6
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Trend in Firefighter Fatalities (1977-2000)</td>
<td>5</td>
</tr>
<tr>
<td>2.2</td>
<td>Percent of Heart Attack Deaths by Year (1984-2000)</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>Type of Firefighter Deaths by Age (1995-2004)</td>
<td>11</td>
</tr>
<tr>
<td>2.4</td>
<td>Immediate Cause of Fatal Injury (1990-2000)</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>Nature of Fatal Injury (1990-2000)</td>
<td>16</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Firefighters must respond to emergency incidents that require extreme physical output and often result in physiological and psychological stressors. Such situations, over time, can affect the overall wellbeing of the firefighting workforce. “Tomorrow’s fire service requires that we face our destiny of keeping our fire fighters fit today” (International Association of Fire Chiefs [IAFC], 2010, p. 2; International Association of Fire Fighters [IAFF], 2010, p. 2). Firefighters are dying in the line-of-duty and efforts to prevent their deaths are failing. “Year after year, there are notable advances in the fire service industry. These advancements range from building code improvement to mandating sprinklers in buildings, from better protective gear to technologically advanced apparatus” (Moore-Merrell, McDonald, Zhou, Fisher, & Moore, 2006, p. 3). Despite the advances in health and safety measures, historically the fatality rate of firefighters remains relatively unchanged since 1977 (USFA, 2009b). Why do firefighters continue to die at such high rates? Why does the fatality rate remain relatively unchanged? Perhaps a more important question is what can be done to reverse the seemingly unchangeable fatality trends, and who is in the best position to help facilitate the necessary behavior changes?

In the course of a day’s work, firefighters selflessly put themselves in harm’s way, risking personal safety for the benefit and protection of society. Firefighters encounter numerous physical hazards including extreme temperatures, high levels of noise, shift work, and long hours. They encounter
musculoskeletal hazards from lifting heavy loads, performing rescues, bending in awkward positions, climbing ladders, and wearing turn out gear that weighs up to 50 pounds. Firefighters also encounter numerous unknown and unexpected hazards including exposure to gases, fumes, and violence; potential for being caught or trapped in buildings or structural collapses; and high levels of psychological stressors. Despite the multitude of occupational risks, firefighters still perform their job duties and serve honorably. They deserve protection from these preventable causes of injury, illness, or death. Current efforts to prevent occupational fatalities in firefighters are not working, particularly prevention of cardiac-related fatalities. The time has come for fire departments in the United States (U.S.) to protect the health, wellness, and safety of its firefighters.

The National Institute of Occupational Safety and Health (NIOSH) Firefighter Fatality Investigation and Prevention Program has documented that few fire departments experiencing on-duty cardiac-related deaths of firefighters have developed and encouraged participation in comprehensive fitness and wellness programs (NIOSH, 2007). A subsequent USFA survey report showed that 76% of fire departments lacked programs to maintain basic firefighter fitness and health (USFA, 2006). Harwood (2008) found that only 39% of fire departments have a health and wellness program, while only 9% have a mandatory fitness program. Federal Emergency Management Agency (FEMA) (2005) also found that most fire departments lack programs to promote physical fitness and health and that the majority of departments do not require firefighters to exercise regularly.
The opportunities for occupational health professionals to impact and reduce the firefighter fatality rates are infinite. The role of the occupational and environmental health nurse (OEHN) in fire departments is infantile in its development, and to date, the OEHN has been underutilized. The OEHN has a unique multidisciplinary role to fulfill and can serve as an agent of change in the fire departments by promoting and protecting firefighters’ health, wellness, and safety. As history has demonstrated by a seemingly unchangeable firefighter fatality rate, a new approach to the prevention of occupational fatalities in firefighters must be discovered and instituted.

This paper will provide a systematic review of the current literature, further elaborate on the 2008 firefighter fatality statistics, discuss in depth the two leading causes of occupational fatalities in firefighters, and discuss the role of the occupational and environmental health nurse. The interdisciplinary role of the OEHN in the prevention of occupational fatalities in firefighters through health and wellness promotion, and primary, secondary, and tertiary prevention will be discussed. Finally, the role of the OEHN in firefighter health surveillance, education and counseling, implementing change, and joining with key stakeholders in the prevention of occupational fatalities in firefighters will be covered. Recommendations for future policy, practice, and research will then be provided.
CHAPTER II

LITERATURE REVIEW

Each year NFPA collects and compiles data on all firefighter fatalities in the U.S. resulting from injuries or illnesses that occurred while firefighter victims were on duty. The incidence of firefighter fatalities peaked in 1978 at 171, began a downward trend to a low of 77 in 1992, and then began to trend upward again to 105 in 1993 (Figure 2.1). Since 1999, the incidence of firefighter casualties in the U.S. ranged from 101 to 119 (Table 2.1). Although the number of firefighter fatalities has steadily decreased over the past 20 years, the incidence of firefighter fatalities per 100,000 incidents has increased. Despite a downward dip in the early 1990s, the level of firefighter fatalities returned to the same levels experienced in the 1980s (USFA, 2009b).

According to NFPA (2009), a total of 118 on-duty firefighter deaths occurred in the U.S. during 2007 and 2008. It is also the fourth time in the last 10 years that the annual incidence of firefighter fatalities has been 118. The average number of firefighter deaths over the last ten years is 101, excluding the 340 firefighter deaths in 2001 at the World Trade Center. The incidence of firefighter fatalities is influenced by the criteria used to determine an on-duty fatality and the numbers can be revised years later. As a result of the differing criteria, it is not uncommon for the numbers to fluctuate annually and the number of fatalities quoted in the literature may differ slightly depending on the time and the source referenced.
FIGURE 2.1
TREND IN FIREFIGHTER FATALITIES
(1977-2000)

Source: FEMA (2002).
TABLE 2.1

FIREFIGHTER CASUALTIES IN THE UNITED STATES

(1999-2008)

<table>
<thead>
<tr>
<th>Year</th>
<th>Deaths¹</th>
<th>Fireground Injuries²</th>
<th>Total Injuries²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>114</td>
<td>45,550</td>
<td>88,500</td>
</tr>
<tr>
<td>2000</td>
<td>105</td>
<td>43,065</td>
<td>84,550</td>
</tr>
<tr>
<td>2001</td>
<td>105³</td>
<td>41,395</td>
<td>82,250</td>
</tr>
<tr>
<td>2002</td>
<td>101</td>
<td>37,860</td>
<td>80,800</td>
</tr>
<tr>
<td>2003</td>
<td>113</td>
<td>38,045</td>
<td>78,750</td>
</tr>
<tr>
<td>2004</td>
<td>119⁴</td>
<td>36,880</td>
<td>75,840</td>
</tr>
<tr>
<td>2005</td>
<td>115</td>
<td>41,950</td>
<td>80,100</td>
</tr>
<tr>
<td>2006</td>
<td>107</td>
<td>44,210</td>
<td>83,400</td>
</tr>
<tr>
<td>2007</td>
<td>118</td>
<td>38,340</td>
<td>80,100</td>
</tr>
<tr>
<td>2008</td>
<td>118</td>
<td>Not available</td>
<td>Not available</td>
</tr>
</tbody>
</table>

Source: USFA (2009c).

¹ This figure reflects the number of deaths as published in USFA's annual report on firefighter fatalities. All totals are provisional and subject to change as further information about individual fatality incidents is presented to USFA.

² This figure reflects the number of injuries as published in NFPA's annual report on firefighter injuries.

³ In 2001, an additional 341 FDNY firefighters, three fire safety directors, two FDNY paramedics, and one volunteer from Jericho (NY) Fire Department died in the line of duty at the World Trade Center on September 11.

⁴ The Hometown Heroes Survivors Benefit Act of 2003 has resulted in an approximate 10% increase to the total number of firefighter fatalities counted for the annual USFA report on Firefighter Fatalities in the United States beginning with CY2004. For more information, please see Reports and Statistics.
The largest share of deaths (39 deaths) occurred while firefighters were responding to emergency calls. Stress, exertion, and other medical-related issues, which usually result in heart attacks or other sudden cardiac events, continue to account for the largest number of fatalities. Of the 41 exertion or stress-related fatalities in 2008, 36 were classified as sudden cardiac deaths. Despite fluctuations in the annual number of deaths due to heart attacks, the trend has remained constant over the past 16 years (Fahy, 2005). Figure 2.2 shows the trend in the percent of heart attack deaths by year from 1984 to 2000.

Definitions

Firefighters

According to NFPA (2008), the nation’s firefighting work force is comprised of three categories of firefighters: career (paid), volunteer, and wildland. There were approximately 1,148,800 firefighters in the U.S. in 2007, an 0.6% increase from 2006. Of the total number of firefighters, 323,350 (28%) were career firefighters and 825,450 (72%) were volunteer firefighters (NFPA, 2008). Almost all volunteer firefighters (95%) serve communities with fewer than 25,000 people whereas career firefighters typically serve in larger metropolitan communities of more than 25,000 people.

For the purpose of calculating fatality statistics, the definition of firefighters includes all members of organized fire departments with assigned fire suppression duties in all 50 States, the District of Columbia, and the Territories of Puerto Rico, the Virgin Islands, American Samoa, the Commonwealth of the
FIGURE 2.2
PERCENT OF HEART ATTACK DEATHS BY YEAR
(1984-2000)

Source: FEMA (2002).
Northern Mariana Islands, and Guam. It includes career and volunteer firefighters; full-time public safety officers acting as firefighters; fire police; state, territory, and federal government fire service personnel including wildland firefighters; and privately employed firefighters, including employees of contract fire departments and trained members of industrial fire brigades, whether full- or part-time. It also includes contract personnel working as firefighters or assigned to work in direct support of fire service organizations (air-tanker crews). The definition includes not only local and municipal firefighters, but also seasonal and full-time employees of the U.S. Forrest Service, Bureau of Land Management, Bureau of Indian Affairs, U.S. Fish and Wildlife Service, National Park Service, and State wildland agencies. The definition also includes prison inmates serving on firefighting crews; firefighters employed by other governmental agencies, such as the U.S. Department of Energy (DOE); military personnel performing assigned fire suppression activities; and civilian firefighters working at military installations (Fahy, 2005).

The definition of firefighters cited above will be used. For the purpose of this paper, however, wildland firefighters will be excluded as wildland firefighting encompasses a vastly different environment with its own set of unique challenges.

**Line-of-Duty Death**

Line-of-Duty Death (LODD) is defined as a death occurring at the scene of an alarm, whether fire or non-fire incident; while responding to or returning from an alarm; while participating in other fire department duties such as training,
maintenance, public education, inspection, investigation, court testimony, or fund raising; and being on call or stand-by for assignment at a location other than a firefighter’s home or place of business (NFPA, 2009). On-duty fatalities include any injury sustained in the line-of-duty that proves fatal, any illness incurred as a result of actions while on duty that proves fatal, and fatal mishaps involving non-emergency occupational hazards that occur while on duty. Illnesses (including heart attacks) are included when the exposure or onset of symptoms occurred during a specific incident or on duty activity (NFPA, 2009). NFPA provides clarification regarding the criteria of LODD and acknowledges the limitations of the definition. According to NFPA (2009),

Fatal injuries and illnesses are included even in cases where death is considerably delayed. When the injury and the death occur in different years, the incident is counted in the year of the injury. NFPA recognizes that a comprehensive study of firefighter on-duty fatalities would include chronic illness (such as cancer or heart disease) that prove fatal and that arise from occupational factors. In practice, there is no mechanism for identifying fatalities that are due to illnesses that develop over long periods of time. This creates an incomplete picture when comparing occupational illnesses to other factors as causes of firefighter deaths. (p. 3)

**Demographics**

**Age**

From 1995 through 2004, the age of firefighters who died ranged from 17 to 81 (Figure 2.3). The firefighters who died in 2008 ranged in age from 17 to 82,
FIGURE 2.3

TYPE OF FIREFIGHTER DEATHS BY AGE


with a median age of 43 years. Approximately 60% of firefighters were over the age of 40 when they died and 33% were over age 50.

The youngest firefighter killed on duty in 2008 was a 17 year old male volunteer firefighter who responded to an automatic fire alarm call from his residence in a privately owned vehicle (POV) when he was involved in a crash (USFA, 2009a). The oldest firefighter killed on duty in 2008 was an 82 year old male who died of a heart attack while helping to reopen a local highway after an automobile crash (USFA, 2009a). NFPA (2009) found that sudden cardiac death accounts for a higher proportion of deaths among older firefighters. In 2008, more than half of the firefighters over age 40 died from heart attacks or other cardiac events. The youngest victim of sudden cardiac death was age 24 and had severe artherosclerosis. Younger firefighters were more likely to have died as a result of traumatic injuries such as from an apparatus accident (motor vehicle accident-related).

Nationally, career firefighters over the age of 40 comprise 46% of the fire service, with those over 50 accounting for only 16% of firefighters. Nine of the 118 firefighter fatalities in 2008 were over the age of 70 (USFA, 2009b). The aging firefighter work force creates challenges not unlike those faced by the 21st century work force in general. However, the issue of age and how it contributes to risk of occupational fatalities in firefighters is challenging to address. Approximately 800,000 of the U.S. one million person firefighting work force is comprised of volunteer firefighters, and the majority of the small, rural communities depend on the volunteer force for its firefighting needs. There is no
doubt that older workers serve a valuable function in the volunteer forces, but what that role should be is an important future topic of discussion and debate. USFA addresses the issue of older workers but has not yet established a formal opinion or guidance on the subject. Fahy (2005) states, “although older firefighters possess a wealth of invaluable knowledge and experience, they are killed while on duty at a rate disproportionate to their representation in the fire service. Also, these older firefighters tend to be affiliated with volunteer agencies” (p. 18). About 40% of volunteer firefighters are over the age of 50, compared to only 25% of career firefighters (USFA, 2009b).

**Gender**

Historically firefighting has been, and still remains today, a male dominated career force. Since 1990, 67 of 2,335 (2.8%) of firefighters who died while on duty were female (USFA, 2009b). Five (4%) of the 118 firefighters who died in 2008 were female and 113 (96%) were male. In the career fire departments, the number of female firefighters is slightly higher than in the volunteer departments. Huelett, Bendick, Thomas, and Moccio (2008) report that of the 350,000 paid firefighters, the 2000 census reports that women number slightly more than 11,000 or 3.7%. “This figure places firefighting in the lowest 11% of all occupations in terms of women employees”(Huelett et al., 2008, p. 1). Given the small numbers of women in the firefighting work force, the fatality rate for women is proportionally equal to that of their male counterparts.
Fatality Statistics

Work-Related Incidence of Firefighter Deaths by Cause of Injury

Fahy, LeBlanc, and Molis (2009) define firefighter fatality cause of injury as, “the action, lack of action, or circumstances that resulted in the fatal injury” (p. 3). FEMA (2002) conducted a firefighter fatality retrospective study and found the leading cause of fatal injury, overexertion/strain (46.6%), is consistent with the high incidence of deaths from heart attacks and accounts for nearly half of firefighter deaths. Other leading causes of firefighter injuries are being trapped, caught, or lost in a structure (18.2%); fire apparatus collisions (12.6%); and being struck by an object (e.g., vehicle, apparatus, falling debris in a structure) (9.4%) (Figure 2.4). Fahy et al. (2009) found:

In 2008, over half of all on duty firefighter fatalities were from traumatic injuries, including internal trauma, asphyxiation, crushing injuries, burns, drowning, and electrical shock. Other firefighter fatalities (about 44%) were due to cardiovascular causes, primarily sudden cardiac death (heart attacks) from stress or overexertion. (p. 3)

Work-Related Incidence of Firefighter Death by Nature of Injury

NFPA (2009) defines nature of death as “the medical process by which death occurred and is often referred to as cause of death on autopsy reports” (p. 4). From 1990 to 2000, the immediate cause of fatal injuries to firefighters was heart attack (44%), followed by trauma, including internal trauma and head injuries, as the second leading type of fatal injury (27%) (Figure 2.5) (FEMA, 2002). In 2008, the largest number of fatalities (38%) were due to internal
FIGURE 2.4

IMMEDIATE CAUSE OF FATAL INJURY

(1990-2000)

Source: FEMA (2002).
FIGURE 2.5

NATURE OF FATAL INJURY

(1990-2000)

Source: FEMA (2002).
trauma. The other major categories were sudden cardiac death (35%), burns (7%), asphyxiation (6%), and stroke (4%) (Fahy et al., 2009).

**Incidence of Type of Duty at the Time of Death**

Kales, Soteriades, Christophi & Christiani (2007) found:

Deaths from coronary heart disease were associated with suppressing a fire (32.1% of all such deaths), responding to an alarm (13.4%), returning from an alarm (17.4%), engaging in physical training (12.5%), responding to non-fire emergencies (9.4%), and performing nonemergency duties (15.4%). As compared with the odds of death from coronary heart disease during nonemergency duties, the odds were 12.1 to 136 times as high during fire suppression, 2.8 to 14.1 times as high during alarm response, 2.2 to 10.5 times as high during alarm return, and 2.9 to 6.6 times as high during physical training (odds based on three estimates of the time firefighters spend on their duties). (p. 1207)

**National Fire Protection Association (NFPA) Standards**

The NFPA develops, publishes, and disseminates many consensus standards and codes to minimize the effects of fire and other risks. Standards are consensus written on topics affecting fire departments and NFPA recommends that the standards be followed to ensure a safer operating environment for firefighters. Compliance with NFPA standards is strictly voluntary. However, in some instances, Federal or State Occupational Safety and Health (OSHA) agencies have incorporated wording from NFPA standards into regulations, making compliance with the standards mandatory. Failure to follow NFPA
standards may be used against fire departments in civil lawsuits. In establishing the standard of care for rescue operations, the courts will frequently look to the ‘voluntary’ standards used by NFPA and other organizations. Although ‘voluntary’ in name, these standards can become, in effect, the legally enforceable standards for fire departments.

Applicable NFPA standards are: NFPA 1500, Standard on Fire Department Occupational Safety and Health Program; NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments; NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters; and NFPA 1901, Standard for Automotive Fire Apparatus.

**NFPA 1500, Fire Department Occupational Safety and Health Program**

The 2007 edition of the NFPA 1500 provides the current standard for fire department occupational health and safety programs. NFPA 1500 section 4.3.1 requires that the fire department adopt an official written departmental occupational safety and health policy that identifies specific goals and objectives for the prevention and elimination of accidents and occupational injuries, exposure to communicable disease, illness, and fatalities (NFPA, 2007).

According to NFPA (2007),

This standard continues to emphasize medical and physical fitness capabilities, the use of incident management, and communication issues.

This standard continues to emphasize these areas, as well as provides updates to the requirements and references to other standards. These
include other referenced NFPA standards in the areas of personal protective clothing and equipment, fire apparatus, training, medical requirements, and other areas. (p. 1)

Health and Fitness Coordinator (HFC)

To increase the effectiveness of and compliance with the fire department’s fitness program, NFPA 1500 recommends that each department appoint a Health and Fitness Coordinator (HFC). The standard recommends that the HFC be a member of the fire department or an outside agent as designated by the fire department, report to the fire chief, act as a direct liaison between the fire department’s health and safety officer, act as a direct liaison between the fire department’s physician, and administer all components of the health-related fitness program. The HFC can also be responsible for administering the needs assessment. The role of the HFC could be effectively filled by an OEHN who can contribute a wealth of knowledge and experience and would be able to implement all the functions listed above.

NFPA 1582, Comprehensive Occupational Medical Program for Fire Departments

NFPA 1582 contains descriptive requirements for a comprehensive occupational medical program for fire departments. The purpose of the standard is to reduce the risk and burden of fire service occupational morbidity and mortality, while improving the safety and effectiveness of firefighters who protect civilian life and property (NFPA, 2003). NFPA 1582 defines roles and responsibilities of the fire department, fire department physician, and candidate
and member. NFPA 1582 defines 13 essential job tasks that require firefighters to wear or utilize specialized personal protective equipment (PPE) that can increase weight, environmental isolation, sensory deprivation, and/or dehydration potential above the levels experienced with standard fire suppression PPE (NFPA, 2003). Lastly, the NFPA defines all medical conditions as either Category A or B conditions. The presence of Category A conditions excludes firefighters from active duty. Category B conditions may also be exclusionary depending on their severity.

**Components of Standard 1582**

NFPA 1582 requires that a complete occupational medical evaluation be performed on all firefighters at baseline and annually thereafter. Each medical evaluation shall include a medical history, complete physical examination with vital signs, and complete examination of the body systems. Several blood tests are required including, CBC with differential, electrolytes, renal function, glucose, liver function tests, total cholesterol, and prostate specific antigen (PSA). Other required tests are urinalysis, spirometry, chest x-ray, audiometry, and mammograms for females over the age of 40.

NFPA 1582 also recommends an annual occupational fitness evaluation of all firefighters. According to NFPA (2003), fitness evaluations shall be mandatory for all members, be part of a comprehensive fitness and wellness program as required by NFPA 1583, and be conducted under the auspices of the fire department physician. An annual fitness evaluation shall include: body weight and composition (BMI, hydrostatic weighing, skin fold, or Bio impedance
analysis), and evaluation of aerobic capacity (using either a stairmill or treadmill),
muscular strength (using grip strength, leg strength, and arm strength), and
muscular endurance (push-up and curl-up evaluation) (NFPA, 2003).

**NFPA 1583, Health-Related Fitness Programs for Firefighters**

NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters, recommends that a fitness program contain certain components. According to NFPA (2008), fitness programs for firefighters should include:

- An educational program that describes the components and benefits of exercise, fitness, fitness training, and weight management;
- An individualized exercise prescription based on the results of the fitness assessment;
- Warm-up and cool-down exercise guidelines;
- Aerobic exercise program;
- Muscular (strength, endurance) exercise program;
- Flexibility exercise program;
- Healthy back exercise program;
- Safety and injury prevention program; and
- Body composition.

**Candidate Physical Ability Test (CPAT)**

There are programs that establish an entry level and baseline fitness level for all new recruits. The Candidate Physical Ability Test (CPAT) was developed in response to the need for a fair and consistent evaluation tool to assist in the
selection of firefighters, and to ensure that all firefighter candidates possess the physical ability to complete critical tasks effectively and safely (USFA, 2009c). The CPAT consists of a series of eight events designed to simulate the firefighting work environment. Candidates don a 50 pound vest to simulate the weight of a SCBA and firefighter protective clothing. An additional 25 pounds is added to firefighters’ shoulders during the stair climb event to simulate the high-rise pack. Firefighters are required to wear long pants, a hard hat with a chin strap, work gloves and footwear with no open heel or toe. Firefighters then proceed through a pre-determined path to complete the eight sequenced events while allowing an 85-foot walk between events. The eight events are the stair climb, hose drag, equipment carry, ladder raise and extension, forcible entry, search maze, rescue, and ceiling breach and pull (IAFC 1999; IAFF, 1999). The CPAT establishes a baseline level of physical fitness for firefighters. A mandatory yearly administration of the CPAT would be beneficial in maintaining a baseline level of fitness and should be considered.

**NFPA 1901, Automotive Fire Apparatus**

The NFPA 1901 standard applies to all vehicles used for structural firefighting, mobile water supply, rescue stations, hazardous material releases, and other incidents not involving wildland firefighting (NFPA, 2009). Updated to provide better safety and effectiveness of fire apparatus, the 2009 NFPA 1901 defines the requirements for new automotive fire apparatus designed to be used under emergency conditions for transporting personnel and equipment, and to support the suppression of fires and mitigation of other hazardous situations. The
2009 edition of the NFPA 1901 contains several important changes designed to address motor vehicle safety issues.

Physical Fitness Standards

There are multiple agencies which have physical fitness standards including the NFPA, OSHA, International Association of Fire Fighters (IAFF), International Association of Fire Chiefs (IAFC), U.S. Fire Administration (USFA), National Volunteer Fire Council (NVFC), and the National Fallen Firefighter Foundation (NFFF). However, despite the existence of a plethora of fitness standards, firefighter fitness remains well below the recommended levels, and few fire departments offer fitness programs. Because no national mandatory fitness standard for firefighters exists, there is variability on firefighter fitness across fire departments (Byczek, Walton, Conrad, Reichelt, & Samo, 2004).

Cady, Thomas, & Karwasky (1985) found that regular physical fitness programs for firefighters have been shown to have beneficial effects. However, many fire departments do not require their firefighters to maintain the initial high levels of physical fitness throughout their careers (Horowitz & Montgomery, 1993).

NIOSH recommends that fire departments develop and participate in comprehensive health and wellness programs. NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters, also stipulates that fire departments establish and provide health-related fitness programs that enable members to develop and maintain a level of health and fitness to safely perform their assigned job functions (NFPA, 2000). Research has demonstrated that virtually all individuals will benefit from regular physical activity (U.S. Department of Health
and Human Services [U.S. DHHS], 2010). A Surgeon General’s report on physical activity and health concluded that moderate physical activity can reduce substantially the risk of developing or dying from heart disease, diabetes, colon cancer, and high blood pressure (U.S. DHHS, 2010). The Healthy People 2010 report shows that the role of physical activity in preventing coronary heart disease (CHD) is of particular importance, given that CHD is the leading cause of death and disability in the United States. According to Healthy People 2010:

Physically inactive people are almost twice as likely to develop CHD as persons who engage in regular physical activity. The risk posed by physical inactivity is almost as high as several well-known CHD risk factors, such as cigarette smoking, high blood pressure, and high blood cholesterol. Physical inactivity, though, is more prevalent than any one of these other risk factors. People with other risk factors for CHD, such as obesity and high blood pressure, may particularly benefit from physical activity. (U.S. DHHS, 2010. p. 1)

Carnethon, Gulati, and Greenland (2005) found strong and consistent evidence from observational studies that physical inactivity and poor cardiorespiratory fitness are associated with higher mortality and morbidity from all causes, including cardiovascular disease (CVD) and cancer.

Given the increased physiological and psychological stressors that firefighters face in the line of duty and because sudden cardiac death continues to remain the leading cause of firefighter fatalities, physical fitness is paramount. Without an optimal level of fitness, firefighters are at an increased risk for causing
injuries to themselves and others (Lavender, Conrad, Reichelt, Johnson, & Meyer, 2000). The strenuous and hazardous demands of firefighting require firefighters to possess optimal physical fitness (Sothmann, Saupe, Jasenof, & Blaney, 1992; Swank, Adams, Barnard, Berning, & Stamford, 2000). Firefighters who are in good physical condition are better prepared to perform and withstand the extreme firefighting environment including aerobically challenging physical work, physical and chemical exposures, and often long and unpredictable work hours. If firefighters are physically unfit, they will be unable to perform their job tasks safely and effectively which not only jeopardizes the safety of the individual firefighter, but also their fellow firefighters and the public at large.

**OSHA Standards**

Several applicable OSHA standards pertain to fire departments. Most OSHA standards have an educational component as well as a need for assessment and monitoring.

- Section 5(a)(1), often referred to as the General Duty Clause. This section requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees" (U.S. Department of Labor [U.S. DOL], 1970, p. 1). It covers general hazards not covered under other specific OSHA standards. Hazards covered under the General Duty Clause include protection from slips, trips, and falls on wet fire department floors, protection from injury
during call response (i.e., knee and ankle injuries from sliding down the fire pole), and other hazards present in the firefighters’ environment.

- 29 CFR 1910.95, Occupational Noise Exposure. Firefighters are exposed to increased noise levels from sirens, bells, loud speakers, and alarms. The major provisions in summary state that hearing conservation programs must be available to all employees whose time weighted averages (TWAs) equal or exceed 85 dB(A). Employers must monitor, at least once, the noise exposures of workers whose TWAs are 85 dB(A) or greater. Remonitoring is necessary with a change in equipment or work process that causes a significant increase in exposure level. All continuous, intermittent, and impulsive noise between the levels of 80 and 130 dB(A) must be included in the exposure assessment. Area monitoring is permitted, but employers must use personal exposure monitoring when there is considerable variation of noise level over time (U.S. DOL, 2006a).

- 29 CFR 1910.134, Respiratory Protection Program. Firefighters are exposed to smoke, toxic and potentially lethal fumes, such as carbon monoxide, and other hazards which require the use of a self-contained breathing apparatus (SCBA). This standard requires the employer to develop a written respiratory protection program, including procedures for: selecting respirators; conducting medical evaluation of employees who will wear respirators; fit testing for tight-fitting respirators (e.g., SCBA); educating workers on proper use of respirators, including cleaning, disinfecting, storing, inspecting, repairing, discarding, and
otherwise maintaining respirators; monitoring adequate air quality, quantity, and flow of breathing air for atmosphere supplying respirators (e.g., SCBA); training employees about the respiratory hazards to which they will potentially be exposed; training employees in proper use of respirators, including donning, doffing, limitations in use, and their maintenance; and regularly evaluating the effectiveness of the respiratory protection program (U.S. DOL, 2006b).

• 29 CFR 1910.1030, Bloodborne Pathogens. This standard applies to all employers with workers who may come in contact with blood or other body fluids while on duty. Firefighters respond to emergency scenes, including motor vehicle accidents (MVAs) and other traumas, where they are exposed to blood and other bodily fluids. Concurrently, accident scenes frequently contain broken glass, sharp metal, and other hazards that could injure firefighters and increase their risk of contamination from bloodborne pathogens. Bloodborne pathogens include the Hepatitis B Virus (HBV) and the Human Immunodeficiency Virus (HIV). Other potentially infectious materials covered under this standard include semen, vaginal secretions, cerebrospinal fluids, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, and all body fluids where it is difficult to differentiate between body fluids (accident scenes). In order to comply with the standard, employers must: develop a pre-exposure and post-exposure control plan; train employees on bloodborne pathogens; provide Hepatitis B vaccinations to applicable employees;
provide protective equipment and mandate its use; and keep accurate records (U.S. DOL, 1991).

- 29 CFR 1910.1200, Hazard Communication. Firefighters encounter unknown and potentially dangerous chemicals while responding to calls involving hazardous material accidents such as train or tractor trailer accidents. This standard is intended to address a comprehensive evaluation of the potential hazards of chemicals, and communication of information concerning hazards and appropriate protective measures to employees. It also preempts any legal requirements of a state, or political subdivision of a state, pertaining to this subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; maintaining an inventory and list of hazardous chemicals on file with the fire department so in the event of a fire, the fire department would know what to expect and how best to respond in that given situation, and development and implementation of employee training programs regarding hazards of chemicals and protective measures (U.S. DOL, 1994).
Partnerships

In 2006, the International Association of Fire Fighters (IAFF) partnered with the International Association of Fire Chiefs (IAFC) to form a joint task force to strengthen their greatest assets—firefighters. The ultimate goal of the Fire Service Joint Labor Management Wellness/Fitness Initiative was to improve the quality of life for all firefighters. The project sought to prove the value of investing wellness resources over time to maintain fit, healthy, and capable firefighters throughout their 25-30 + year career and beyond (IAFC, 2010; IAFF, 2010). According to IAFC (2010):

An overall wellness/fitness system must be developed to maintain firefighters’ physical and mental capabilities and should be the objective of every fire department in cooperation with its local IAFF affiliate. While such a program may be mandatory, agreement to initiate it must be mutual between the administration and its members represented by the local union. Any program of physical fitness must be positive and not punitive in design; require mandatory participation by all uniformed personnel in the department once implemented; allow for age, gender and position in the department; allow for on-duty-time participation utilizing facilities provided or arranged by the department; provide for rehabilitation and remedial support for those in need; contain training and education components, and be reasonable and equitable to all participants. (p. 1)

Another option, recommended by the IAFF/IAFC Wellness-Fitness Task Force to increase the successful implementation of the fitness program, is to use
Peer Fitness Trainers (PFT). The Peer Fitness Training Program is a certification provided and sponsored by the IAFF/IACC in conjunction with the American Council on Exercise (AEC). The PFT would be responsible for the design and implementation of the fitness program, to improve the wellness and fitness of the fire department, to assist with the physical training of recruits, and assist the broader community in achieving wellness and fitness.
CHAPTER III

TWO LEADING CAUSES OF LINE-OF-DUTY DEATHS (LODD) IN FIREFIGHTERS

The two leading causes of line-of-duty deaths in firefighters are cardiovascular diseases and internal trauma from motor vehicle accidents. Each will be discussed.

**Cardiovascular Disease**

At first glance, firefighting is undeniably a dangerous occupation. However, many factors lie hidden below the surface which make firefighting an even more dangerous occupation than one would expect. Firefighter mortality rate is expected to be high. What is less appreciated is that the most frequent cause of death among firefighters is cardiovascular disease, rather than burns or smoke inhalation. Acute cardiovascular disease is exacerbated by firefighting duties and firefighting may increase the incidence of cardiovascular disease. It is estimated that 81.1 million individuals in the general population have cardiovascular disease.

Cardiovascular disease continues to be the leading cause of death in the U.S. (American Heart Association, 2010). Kales et al. (2007) found that many firefighters lacked adequate physical fitness, had underlying cardiovascular risk factors, and had subclinical coronary heart disease. The authors also noted that even new firefighter recruits may be overweight and have low-to-normal aerobic capacities, often compounded by a lack of programs to promote physical health in 70% of fire departments. Most fire departments do not require firefighters to
exercise regularly, undergo periodic physical examinations, or have mandatory return-to-work programs. Kales et al. (2007) noted a high prevalence of obesity among firefighters and associating cardiovascular risk factors, and previously diagnosed heart disease with on-duty coronary heart disease (CHD) events and other adverse outcomes. Given the relative importance and high correlation of obesity and lack of physical exercise to sudden cardiac death, these contributing risk factors will be covered in depth in future sections of the paper.

**Sudden Cardiac Death**

Sudden cardiac death (also called sudden cardiac arrest) is the sudden, unexpected loss of heart function, breathing, and consciousness resulting from an electrical disturbance in the heart that disrupts its pumping action. Blood flow then ceases to other parts of the body. Sudden cardiac death is different from a heart attack, which occurs when blood flow to a portion of the heart is blocked, depriving the heart muscle of necessary oxygen. Like a heart attack, however, the underlying reason for sudden cardiac death is coronary heart disease (Mayo Clinic, 2008).

“Cardiovascular events, largely due to coronary heart disease, account for approximately 45% of deaths among firefighters on duty” (Kales et al., 2007, p. 1208). Kay, Lund, Taylor & Herbold (2001) found that firefighters experience more occupational fatalities due to heart attack than persons in any other profession.
Contributing Factors

When considering plausible factors for the higher CHD related firefighter mortality rates, Kales et al. (2007) evaluated and compared mortality rates from other dangerous occupations to the rates found in firefighters. They found:

Possible factors, such as physical exercise and emergency responses, are not unique to firefighting; they are also characteristic of the work performed by police officers, military personnel, and persons in various other occupations. . . . In contrast, such events, account for 22% of deaths among police officers, 11% of deaths among on-duty emergency medical services workers, and 15% of all deaths that occur on the job. (p. 1208)

Physiological and Psychological Stressors of Firefighting

The performance of fire suppression entails sporadic high levels of physical exertion, uncontrolled environmental exposures, and psychological stress from observing intense human suffering. Firefighters experience high numbers of line-of-duty deaths from occupational diseases, forced medical retirements, and line-of-duty injuries. Kales et al. (2007) stated:

Various biological plausible explanations for high mortality from cardiovascular events among firefighters have been proposed. These explanations include smoke and chemical exposures, irregular physical exertion, the handling of heavy equipment and materials, heat stress, shift work, a high prevalence of cardiovascular risk factors, and psychological stressors. (p. 1208)
Geibe et al. (2008) found:

Recent evidence supports that coronary heart disease (CHD) events are often precipitated by strenuous duties. Biologic-plausible explanations include the efforts of heavy protective equipment, irregular physical exertion, gaseous and particulate smoke exposures, and psychological stressors in patients with underlying CHD. (p. 585)

In another case control study to evaluate firefighter on-duty deaths from coronary heart disease, Kales, Soteriades, Christoudias, and Christiani (2003) found:

Numerous occupational factors could precipitate CHD events in firefighters. First, firefighting includes long sedentary stretches followed by irregular heavy exertion. Firefighters react immediately to alarms with significant increases in pulse rate. During fire suppression, they work at near maximal heart rates while wearing about 50 pounds of protective equipment, sometimes for prolonged periods. Heat stress and fluid losses can result in decreases in cardiac output despite sustained tachycardia. Second, self-contained breathing apparatus use has reduced, but not eliminated chemical exposures including carbon monoxide, particulates and other toxicants. Third, firefighters experience intermittent noise exposure which may increase blood pressure. Fourth, firefighters often perform shift work, which may increase the risk of CHD. (p. 2)

“Firefighters face a much higher risk of death from heart attack when battling a blaze- up to 100 times the normal rate- and are more likely to be struck
down even when they are doing less strenuous tasks” (Harvard School of Public Health [HSPH], 2007, p. 1). A group of public health researchers at Harvard University looked at how much time firefighters spend on various duties. If heart attacks were caused by preexisting conditions—not by on-the-job activities—then deaths during any firefighting duty would be proportional to the amount of time spent on that duty. But the researchers found more-than-expected deaths during firefighting as well as the other activities (HSPH, 2007). Looking at firefighter heart attack deaths nationwide over a decade, the researchers found that the risk of heart attack is greatest when firefighters are working at a fire scene— with increased odds ranging from 10 to 100 times the normal risk of heart attack. Although firefighters spend only about 1% to 5% of their time putting out fires, 32% of firefighter deaths from heart attacks occur at the fire scene (HSPH, 2007). The study also noted that firefighters deal with extreme heat and exertion, and are exposed to toxic substances and psychological stress.

Another contributing factor noted in the literature, however not thoroughly explained, was the risk of death due to CHD in career versus volunteer firefighters. “Unexpectedly, professional and volunteer firefighters had different risks of death from coronary heart disease, depending on the type of duty performed, although for both groups, the risk was highest during fire suppression activities” (Kales et al., 2007, p. 1212).

**CHD Risk Factors**

Certain behaviors and conditions or risk factors increase the risk that firefighters may develop CHD, putting them at a higher risk for sudden cardiac
death. Risk factors for CHD are categorized as un-modifiable and modifiable. Un-modifiable risk factors for CHD include age, gender, and genetic predisposition. The risk of CHD is increased in men 45 years of age and older, and in women 55 years of age and older. The risk of CHD is also increased in individuals who have a family history of early CHD, a father or brother diagnosed before age 55, or a mother or sister diagnosed with CHD before age 65 (National Heart, Lung and Blood Institute [NHLBI], 2010). Modifiable risk factors for CHD include cigarette smoking, high blood pressure, high blood cholesterol, overweight and obesity (increased body mass index [BMI]), physical inactivity, and diabetes (NHLBI, 2010). Byczek et al. (2004) evaluated the cardiovascular risks in firefighters and noted that the prevalence of obesity, elevated total cholesterol, and elevated blood pressure in firefighters exceeded Healthy People 2010 targets. In addition, firefighters’ prevalence of obesity, low high density lipoprotein (HDL), high low density lipoprotein (LDL), and high total cholesterol levels was higher relative to the general population. The positive news is that many of the risk factors for CHD can be reduced.

**Internal Trauma/Motor Vehicle Accidents**

After stress or overexertion, the perennial cause of fatal injury resulting in the most firefighter fatalities is vehicle crashes. Twenty-eight firefighters were killed in 2008 as a result of vehicle crashes. Approximately 25% of the annual firefighter line-of-duty deaths in the U.S. occur as a result of vehicle collision or being struck by a vehicle while operating on the emergency scene. Until recently, the fire service has done little to address this problem (USFA, 2009b). The
consistently high percentage of emergency worker fatalities related to response prompted the Fire Service Emergency Vehicle Safety Initiative (EVSI), a partnership effort among the U.S. Fire Administration (USFA), the U.S. Department of Transportation (DOT), National Highway Traffic Safety Administration (NHTSA), and the DOT/Intelligent Transportation Systems (ITS) Joint Program Office. One of the primary functions of the EVSI was to sponsor the National Forum on Emergency Vehicle Safety, which brought together representatives of major national level fire and emergency service associations and other individuals and organizations with an interest and expertise in emergency vehicle safety.

**Contributing Factors**

**Human Factors**

The participants in the forums for the EVSI identified four categories of human factors that contribute to vehicle crashes: knowledge base, skills, ability, and attitude. According to the FEMA (2004):

- Drivers may lack knowledge of traffic laws, physical laws that govern the apparatus operation, or may lack awareness of potential dangers.
- Inadequate skills in handling apparatus may be the result of insufficient training, lack of hands-on training, inexperience, slowed or improper reaction, or poor judgment. Attitude plays a major role in safe vehicle operations. Failure to obey laws or take proper precautions, improper use of the roads, allowing excitement to lead to impulsive actions, dangerous shortcuts, and irresponsible or reckless behavior all contribute to apparatus
crashes and fatalities. Other factors include inattentiveness, failure to concentrate on driving tasks, and the emotional sense of power and urgency when running lights and siren. This sense can block out reason and prudence, leading to the reckless operation of the emergency vehicle.

(p. 47)

**Non-Compliance with Use of ANSI Approved Safety Vests**

On November 24, 2008, federal regulation 23 CFR 634-Worker Visibility (high visibility vests) went into effect mandating that anyone working in the right-of-way of a federal-aid highway must be wearing high-visibility clothing that meets the class two or three requirements of the American National Standards Institute (ANSI) and the International Safety Equipment Association (ISEA).

ANSI 107 requires that class 2 garments (vests) have at least 775 square inches of high-visibility, fluorescent background material and at least 201 square inches of reflective material (Worker Visibility, 2006).

NFPA 1500 requires firefighters working on traffic assignments where they are endangered by motor vehicle traffic to wear clothing with florescent and retroreflective material. However, some fire service personnel have expressed concern about adding a layer of potentially flammable material between their turnout gear and SCBA while battling car fires or during an extrication. These concerns have led to non-compliance.

**Volunteer Status**

Of those firefighters killed while en route to an incident, 85% were volunteers (USFA, 2009b). Volunteer status as a contributing factor to firefighter
fatalities can be attributed to differences between career and volunteer agencies. Usually, unless they are on call or other fire department business, career firefighter personnel are required to be in the fire station for the duration of their shift which generally ranges from 10-24 hours long. In contrast, volunteer firefighters are not required to reside in the firehouse, making them more likely to die as a result of MVAs than their career counterparts.

**Lack of Seat Belt Use**

About 27% of firefighters killed in motor vehicle accidents were ejected from the vehicle at the time of the collision; only 21% of firefighters were reportedly wearing their seat belts prior to the incident (USFA, 2009b). NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, (NFPA, 2007) recommends,

> All persons riding in fire apparatus shall be seated and belted securely by seat belts in approved riding positions and at any time the vehicle is in motion other than as allowed in section 6.3.4 and 6.3.5. Seat belts shall not be released or loosened for any purpose while the vehicle is in motion, including the donning of respiratory protection equipment or protective clothing. (p. 20)

As part of the National Institute for Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program (FFFIPP), NIOSH conducts investigations of firefighter LODD and formulates recommendations in presentations and publications such as Line-of-Duty Deaths, NIOSH Alerts, and Health Hazard Evaluation reports. In conjunction with the
FFFIPP, a Fire Department Survey was mailed to Fire Chiefs of a stratified and random sample of 3,000 fire departments across the country during spring of 2006. The findings indicate that the vast majority (84.2%) of fire departments require their firefighters to wear seat belts while they are in emergency vehicles. The highest percentages are among departments in the West; in urban, career, and large departments; and in the fire departments with prior FFFIPP investigations (NIOSH, 2007). Twenty-five percent of all fire departments in the Midwest do not require seat belt use in emergency vehicles, and about 20% of fire departments in small jurisdictions do not have a seat belt requirement (NIOSH, 2007). As demonstrated in other areas, career fire departments are more likely than volunteer and combination fire departments to require the use of seat belts, 94.3%, 86.9%, and 82.0%, respectively (NIOSH, 2007). Although greater than 80.0% of fire departments require seat belt use, compliance rates are reportedly quite low. Firefighters in only about half of the nation’s fire departments are reported to use their seat belts “most of the time” or “always” (NIOSH, 2007). Firefighters in urban fire departments are more likely than those in rural departments to “always” wear their seat belts, 22.8% and 16.3%, respectively; 6.3% of fire departments in rural jurisdictions say their firefighters “never” wear seat belts (NIOSH, 2007). Firefighters in career fire departments are more likely than those in volunteer and combination fire departments to “always” use their seat belts when riding in emergency vehicles, 32.0%, 20.9% and 12.8% respectively (NIOSH, 2007).
The topic of seat belt use by firefighters was discussed in three of four focus groups at a National Fallen Firefighters Foundation (NFFF) Firefighter Life Safety Initiatives Program mini summit. The summit participants were unanimous in underlining the need for more effective measures to ensure that all firefighters use seat belts, whenever they are driving or riding in fire department vehicles. The seat belt issue is one of the prime examples of the cultural change that is essential to improve firefighter safety. While many states and virtually all fire departments have adopted rules or regulations requiring the use of seat belts, the summit participants noted that compliance with these regulations is a serious problem in many fire departments (NFFF, 2006).

The seat belt issue was identified as a top priority, based on the number of preventable fatalities and serious injuries that result from ejection from vehicles that are involved in collisions or falls from moving apparatus. The participants agreed that seat belt usage must be mandatory and enforced. The seat belt issue was identified as a personal accountability problem, while the failure to enforce seat belt regulations was described as a management and supervisory issue (NFFF, 2006).

The participants encouraged further research and development to address reasons why firefighters do not wear seat belts, including the need for more user-friendly seat belt systems in ambulances and better integration of seat belts and SCBA straps in apparatus cabs. A variety of technological measures were proposed, including warning lights and alarms to indicate when a seat is occupied without seat belts fastened, and interlocks that would prevent starting or moving a
vehicle until everyone on board is properly belted in place (NFFF, 2006). Many of the suggestions brought forth have resulted in changes to the NFPA 1901, Standard for Automotive Fire Apparatus.

**Safety Culture**

The concept of “safety culture” was first coined after the 1986 Chernobyl disaster. Safety culture is difficult to define and even more difficult to change. Firefighter culture is no different. Cooper (2000) defines safety culture as “a sub-facet of organizational culture thought to affect members’ attitudes and behaviors in relation to an organization’s ongoing health and safety culture” (p. 111). Safety culture is used to describe the corporate atmosphere or culture in which safety is understood to be, and is accepted as, the number one priority (Cooper, 2000).

What exactly is the firefighter culture and what makes the task of reducing line-of-duty firefighter fatalities so challenging? There are certain negative behaviors, attitudes, and systems engrained in many fire department cultures. Much of firefighter culture is veiled in secrecy and exists in unwritten and unspoken traditions, making the task of defining that culture even more challenging. Manning (2010), an expert in firefighter culture, describes the need to address firefighter culture.

Our success in reducing deaths and injuries on the job is directly related to our ability to change behaviors and attitudes-to change culture. “Culture change” is the first Life Safety Initiative, from which all others follow; to
do that, we must have a better understanding of what it is and what it isn't.

(p. 1)

He goes on to state:

It's not difficult to understand why, for some, culture change causes neck hairs to stand straight up: For them, "culture change" translates into "assault on tradition." But the goal is the culture change Life Safety Initiative is anything but that. To put it simply: The fire service is an institution whose mission is to save lives and property. Saving lives and property is a 2,000-year fire service tradition. Other customs and traditions have developed in support of that mission and the organization: the tradition of parades, the tradition of fire department funerals, and the tradition of graduation or advancement ceremonies. Fire service traditions are good. Saving lives is a proud fire service tradition. (p. 1)

Another cultural belief which creates an environment of unsafe behaviors is the, “It won’t happen to me” culture. Cooper (2010) states, “People often behave unsafely because they have never been hurt before while doing their job in an unsafe way: ‘I've always done the job this way' being a familiar comment” (p. 1).

Creating a safety culture change will by no means be an easy task and it will not happen overnight. It entails making a paradigm shift and motivating people to buy into the message. It is about getting firefighters to do the right thing, even when no one is watching. To help create a safety culture, the fire department should start with a set of Standard Operating Procedures (SOP) that
place emphasis on safe operating practices. SOPs give concrete guidance to firefighters and allow for training, enforcement, tracking of compliance, positive reinforcement when followed, and possible sanctions if not followed. After SOPs are developed, the next step is to get management support and empower employees. It is essential that a safety culture be created from the top down and from the bottom up. Lastly, when changing the safety culture, it is important to put a “face” to fatalities. Currently firefighters receive NIOSH LODD fatality reports that contain incident information only. They are in essence “sanitized.” The fatalities are nameless and faceless, which does not allow firefighters the opportunity to see the tragic impact that losing the life of a firefighter creates thus not allowing the opportunity to be vulnerable. According to Manning (2010):

Culture change happens company by company, championed by internal safety advocates. It’s about reciprocal accountability, reciprocal leadership. It's a planet that, as it gets larger and stronger, pulls more people into its gravity. It's about infusing greater responsibility into the organizational fabric, demanding that the individual is duty-bound to do what's right for the organization. People who aren't behaving in ways that are good for the organization have no business being there. The culture must support what's good for the organization as a whole so each individual can be served. (p. 3)
CHAPTER IV

THE ROLE OF THE OCCUPATIONAL AND ENVIRONMENTAL HEALTH NURSE IN THE PREVENTION OF OCCUPATIONAL FATALITIES IN FIREFIGHTERS

The Occupational and Environmental Health Nurse (OEHN) provides for and delivers health and safety programs and services to workers and worker populations. The American Association of Occupational Health Nurses (AAOHN) (2009) states:

OHENs are both managers (implement occupational health service programs, provide budgetary input for programs and staffing) and leaders (develop policy and procedures in alignment with company vision and mission, supervise and direct employees, and mentor co-workers) in the effort to impact corporate improvement and workers, worker populations and community groups health and safety, thus contributing positively to the financial bottom line. (p. 1)

OEHNs are currently employed in several of the larger urban fire departments and ideally could serve in a full-time capacity as part of the fire department staff in all departments. However, due to budgetary constraints and workforce size, this may not be realistic. Several options for employing the OEHN are potential job/employee sharing among several fire departments, part-time employment, city or county government employment which also covers the fire department, or utilizing the OEHN in a consultative manner. The OEHN can provide outreach efforts to the small and often isolated rural fire departments that
frequently lack financial, personnel, and informational resources. It is in the small rural departments where the OEHN is needed the most and where a significant impact on health and safety can be made.

Key services the OEHN can provide are:

- **Case Management:** The OEHN can coordinate and manage the care of injured firefighters, including Workers’ Compensation, Family Medical Leave Act (FMLA), short-term and long-term disability, fitness for duty, rehabilitation, and return-to-work programs.

- **Health Surveillance:** The OEHN conducts health surveillance to detect potential illness and injury. Health surveillance in fire departments includes coordinating the department’s hearing conservation, respiratory protection, and bloodborne pathogens program, and providing health risk assessments.

- **Health Promotion and Protection:** Health promotion and protection focuses on the prevention of injury by using strategies directed towards getting firefighters and management to accept responsibility for health, wellness, and safety and modifying behaviors to achieve those goals. The OEHN can perform health examinations and fitness evaluations; manage the department’s physical fitness program; serve as a fitness consultant; assist with networking; and obtain funding (grant writing).
• Education: The OEHN can assist with or provide workshops regarding fitness, nutrition, CHD, smoking cessation, stress management, motor vehicle safety, and health and wellness.

• Counseling: The OEHN can provide much needed counseling services including critical incident debriefing, encouragement, and crisis intervention. The OEHN can also manage the department’s Employee Assistance Program (EAP). The OEHN is nonbiased, impartial, and confidential, which can help to gain the trust of firefighters and allow for open dialogue.

• Legal and Regulatory Compliance: The OEHN has background and knowledge to help fire departments comply with state and federal regulations, such as OSHA.

• Research: The OEHN can help to recognize, identify, monitor, evaluate, and analyze hazards by conducting research. The OEHN can then use the data obtained from the research to design and implement preventative control measures.

**Levels of Prevention**

Preventing disease involves a wide range of interrelated programs, actions, and activities. The goal of disease prevention is to empower individuals to take responsibility for their own health by engaging in health promoting behaviors and avoiding risk taking behaviors. Levels of prevention are stratified into three levels: primary, secondary, and tertiary. The goal of primary prevention is to prevent disease before it occurs. The goal of secondary prevention is to decrease
disease morbidity and mortality by implementing measures to detect disease before it is symptomatic. Generally secondary prevention involves screenings such as blood pressure and blood cholesterol levels. Tertiary prevention goals target individuals affected by disease, attempt to limit morbidity and mortality, and restore individuals to a healthy and functional state.

The OHEN can provide a comprehensive health and wellness promotion program which includes health protection and prevention using primary, secondary, and tertiary prevention strategies. According to Rogers (2003), a major component of occupational and environmental health nursing practice includes activities related to health promotion. Health promotion activities are directed toward enhancing existing levels of health and increasing the level of well-being in order to move toward optimal health and gain control over health determinants. (p. 58)

**Primary Prevention**

Primary prevention of occupational fatalities in firefighters includes interventions in the areas of physical fitness, smoking cessation, nutrition, and motor vehicle safety. The OEHN and fire department can establish a task force to develop a fitness program that is accessible and accommodating to the unique needs of the firefighter. The task force, at a minimum, should include the OEHN, one member of management, one firefighter, and if possible, a health fitness coordinator (HFC) or a peer fitness trainer (PFT). The fire department’s legal counsel should be consulted to discuss issues of liability and insurance coverage, and then a comprehensive needs assessment should be conducted. The needs
assessment should include design, coordination, and monitoring of the fitness program; the unique needs of the particular department; availability of funding; employee desire for a fitness program and expected participation; different types of programs firefighters would attend; when to offer the programs, e.g., during work hours or after; availability or lack of space; special constraints (such as volunteer versus career force); and availability of community resources.

Secondary Prevention

The OEHN provides secondary prevention activities such as performing health examinations, performing fitness evaluations, and conducting screenings such as blood pressure, cholesterol, glucose, and alcohol/drugs. NFPA 1582 and 1583 define the requirements of a comprehensive occupational medical and fitness program. However, the NFPA standards are voluntary and during evaluations of firefighter fatalities, findings were consistent: a medical examination and fitness evaluation had not been performed in the previous year, particularly in those departments who had not suffered a previous fatality.

Based on the needs of the individual fire department, the OEHN can perform health evaluations or assist the physician with performing the examinations as well as providing referrals for abnormal findings from screenings. The OEHN maintains certifications in spirometry and audiometry and can conduct required annual pulmonary function and audiometric testing, as well provide follow up for firefighters who have deficits during testing. The OEHN can provide oversight of the fitness evaluations including body composition, evaluation of aerobic capacity, muscular strength, and muscular endurance.
Tertiary Prevention

The OEHN can provide case management and oversee rehabilitation for firefighters recovering from work-related injuries or those who have been found unfit for duty. Proper rehabilitation and case management can assist in returning firefighters to full functional capacity, enabling a return to duty as quickly as possible. The OEHN can serve in an interdisciplinary function, providing coordination among firefighters, the fire department physician, personal physicians, and the fire chief which is important for post-injury management and fatality prevention.

Education, Training, and Counseling

Education, training, and counseling are perhaps the most important functions the OEHN can fulfill. The messages can only be effective if they reach their target audience, and the OEHN can deliver the important health/wellness and fitness messages to firefighters. Once the message is delivered the OEHN can also assist in keeping the message alive.

Based on the findings from a 2006 survey, firefighters reported wanting information in a form that could be readily used for training (NIOSH, 2007). There was also widespread interest among the training officers in receiving pre-made NIOSH training materials based on the LODD reports. The training officers stated, “It would be extremely valuable to get some audio-visual supporting materials” (NIOSH, 2007, p. 7). The OEHN could design a modular audiovisual training program of 30-60 minute videos with topics covering general health and wellness (fitness, nutrition, CVD, smoking cessation, healthy cooking
lessons, etc.), as well as PowerPoint presentations with talking points based on current NIOSH LODD reports. The PowerPoint presentations would give the OEHN the opportunity to provide education and training that is timely and pertinent to current issues facing firefighters. Also, these presentation could include pictures and real life to “put a face” to the fatalities. Firefighters could view the videos during down time, meal times, exercise time (treadmill, stairmill, etc.) and during department staff meetings and in-services.

**Nutrition**

Addressing the poor nutritional habits of firefighters and implementing change is a challenge. The fire house meal has been known to be one of the central cornerstones of the firefighters’ work place life and the fire house meal has become a cultural experience. Firefighters can spend up to 24 hours on duty in the fire station and meals are frequently eaten in large groups. Food provides the essential fuel firefighters need to perform under extreme and physically challenging work conditions, but it also provides a bond between them. Meal times are important as firefighters join together and decompress between calls.

Time constraints are a barrier to proper nutrition for firefighters. Firefighters are on call and can be pulled away from the fire station at any time. Fast food is a fast, easy, and convenient way for firefighters to eat allowing them to return to their duties quickly. Preparing fresh and nutritious meals requires time spent shopping for the food, putting the food away at the firehouse, and cleaning and preparing the food. Fresh foods are perishable and require more frequent shopping.
Nutritional interventions can be simple and can yield huge results. When implementing a health/wellness and fitness program for firefighters, nutritional interventions are a good place to start. The OEHN can assist the firefighters with setting up a nutritional cooking and eating program. The OEHN can give cooking classes, help with techniques for meal planning and shopping that will work within the constraints of a firefighters work life, and help the firefighters overcome barriers to nutritional change through education and discussion. There are many resources the OEHN or fire departments can use to assist with nutritional education and training specifically targeted for firefighters.

**Designing and Implementing a Fitness Program**

The following sections can serve as a guideline for the OEHN, Health and Fitness Coordinator (HFC), or Peer Fitness Trainer (PFT) to design a physical fitness program. Sherek (2009) states:

It has been said that firefighters expend as much energy during a major emergency as the players during a major football game. This assertion is supported by many studies that demonstrate the need for and benefits of high levels of physical fitness in the fire service. A firefighter is just like an athlete being that they must be properly equipped, skilled at what they do, and fit for the demands of their jobs. (p. 1)

**Site Selection**

When designing and implementing a fitness program, the OEHN needs to decide what type of program best meets the needs of the fire department. When possible, on-site fitness programs are preferable. If the department has funding or
space limitations, an off-site program can be utilized. Pate and Blair (1983) found:

Several factors are known to affect adherence of employees to company-sponsored fitness programs. Of particular importance are program leadership, motivational schema, program activities, convenience of participation, and social support. It is recommended that, where feasible, supervisors of employee fitness programs:

a. Secure professional leadership;

b. Provide on-site or other facilities that maximize convenience;

c. Allow participation across the widest possible time span;

d. Provide programs offering a wide range of activities;

e. Attend carefully to evaluation, recognition, and other motivational concerns; and

f. Incorporate a comprehensive health promotion perspective.

(p. 632)

Although health and wellness should be a top priority for fire departments, frequently it is not. Funding can be a major obstacle for the smaller and rural fire departments that are largely volunteer. For departments facing budgetary constraints, several funding alternatives can be used to assist in setting up an on-site fitness program. USFA’s (2007) guide, Funding Alternatives for Fire and Emergency Medical Services, presents several ideas for funding different types of fitness programs, including:
• Fees for service;
• Grants from agencies such as USFA Assistance to Firefighters Grant (AFG) Program;
• Interacting and networking; contact State fire and EMS offices, associations, public officials or decision makers, and occupational safety and health organizations;
• Foundations and corporate donations; Large foundations, community service clubs, and corporations often provide funding or in-kind donations (such as equipment) if they feel the need is worthwhile;
• Partnerships; and
• Fundraising. (p. 29)

Alternatives to on-site fitness programs include government installations, local colleges and universities, local YMCA’s, and private fitness centers. Private fitness centers may be willing to offer services at a reduced fee with a certain number of participants or long term contracts. The OEHN should explore these options.

Incentives

It is not clear whether incentives increase compliance and participation in fitness programs over time. The USFA (2009c) found:

Non-incentivized fitness programs generate poor levels of participation, but traditional “achievement awards” (such as workout equipment or certificates) demonstrate a 20 to 40% participation rate. Financial or
personal incentives are most effective. Average participation, or use rates, for such incentive based programs average 50 to 60%. (p. 49)

Incentives could help increase participation such as cash or gift drawings, schedule priority (for those departments with self scheduling), paid time off, choice of fire house duties, public recognition at the fire house (e.g., the fit firefighter bulletin board), reduced or supplemented insurance premiums, heart healthy cookbooks, and free fitness center memberships. Using information from the initial needs assessment, the OEHN should determine if incentives should be used.

Voluntary Versus Mandatory

The USFA Health and Wellness Guide updated the status of the fitness programs of sixteen previously studied fire departments. The evaluation found that voluntary programs generally experienced low participation and early demise whereas mandatory programs, such as the Howland Fire Department in Ohio, experienced a 95% success rate. Due to recent union negotiations, the contract requires that all paid members participate in a mandatory physical fitness program. Research shows that the fitness programs with the highest participation rates and greatest popularity are those that are mandatory, on-site, with demonstrated support of the program by management and the personal commitment to fitness by the members (USFA, 2009c).

Implementing Change

Implementing change in fire departments is difficult. Much of the current behavior and traditions were established long ago and remain firmly engrained in
fire departments. The OEHN can provide needed motivation and support to assist firefighters with overcoming barriers to change and contribute to successful implementation of change. Whether desired behavior change is increased physical fitness, weight loss, improved nutrition, smoking cessation, increased seatbelt use, decreased unsafe behaviors, understanding the theories and stages of behavior change are applicable and can assist with accomplishing the preferred goals. Behavior change is complicated. Behavior change also does not occur overnight; instead, it is a long process that requires a long-term commitment from the participant. Health-related behavior changes should be viewed as a lifestyle modification, and the goal should be to maintain the changes permanently.

**Theories of Behavior Change**

One model of change addressed in the literature is the Stages of Change model (Greene, Rossi, Reed, Willey, & Prochaska, 1994). This model was initially developed to use with overcoming addictive behaviors which makes it a useful model for not only addressing nutrition and smoking cessation, but for other behavioral changes. The five stages of behavior change are: precontemplation, contemplation (plans to change within the next six months), preparation (plans to change within next one month), action (continues change for greater than six months), and maintenance. Movement across stages rarely follows a linear path from one stage directly to the next, rather it is more likely to follow a progression and regression pathway. The OEHN should consider these stages of behavior change when addressing the occupational health needs of firefighters.
Cooper (2000) describes another behavior change theory called Goal-Setting. The Goal-Setting theory states that creating a behavior change is best accomplished by dividing the main goal (super-ordinate goal) into a series of sub-goals that are intended to direct people’s attention and actions toward the desired behavior. According to Cooper (2000), “Dividing the task into more manageable sub-goals that are in themselves challenging and difficult should lead to much greater overall goal attainment of the super-ordinate goal” (p. 116).

**Barriers to Change**

In addition to the difficulty faced when trying to create and/or change the safety culture, another barrier to change has been described by a 22 year veteran assistant fire chief as the, “firefighter duty-to-die syndrome.” Crawford (2007) states:

The syndrome is a firefighter’s behavior that reflects a sense of obligation and duty to unnecessarily risk personal and others’ safety above what is appropriate or required according to standards. The firefighter does this to fulfill an intrinsic, environmental or cultural notion that risk is expected and acceptable, even to the point of death. This can be a full or partial condition, with the range often dependent on the level of the institutionalization of risky behavior by the culture of the department, groups, or organization of which the firefighter is a member. (p. 41)

**Politics and Legislation**

Rogers (2003) describes key OEHN competencies and performance criteria in the regulatory and legislative process. She states:
An expert nurse influences the occupational and environmental health legislative and regulatory public policy, advances occupational and environmental health and safety by influencing related policy, and initiates efforts to gain national support for occupational and environmental health and safety policy. (p. 72)

With the exception of a select few occupational and environmental health programs implemented as part of the fire service joint labor management wellness/fitness initiative, occupational and environmental health programs in fire departments do not exist. Given the current milieu of fire departments in which budgetary concerns are present, occupational and environmental health programs are lacking, and mandatory medical screening and fitness standards for firefighters do not exist, the OEHN has an opportunity to make or advocate for significant changes in fire department policy and legislation. The OEHN can use his/her expertise to influence the legislative process to advocate for increased funding for occupational and environmental health programs in fire departments as well as advocate for mandatory medical and fitness standards for all firefighters. The OEHN can also monitor the current status of bills and legislation not only to get the legislation passed, but also ensure that it continues.

**Legislative Bills**

There are currently two major legislative bills affecting firefighters pending approval: House of Representatives Bill 1499 (2009) and Senate Bill 602 (2009), both known as The Firefighter Fatality Reduction Act of 2009. The bills were first introduced in 2008 into the House and Senate but failed to pass and
were introduced again in 2009. The Firefighter Fatality Reduction Act of 2009 directs the Secretary of the Department of Homeland Security to survey fire departments to determine the level of compliance with national voluntary consensus standards and any barriers to achieving compliance with such standards, and for other purposes. The bill states seven key findings to reduce firefighter fatalities. The OEHN should remain active and engaged in the legislative process by monitoring the status of current and proposed bills, encourage key stakeholders to support pertinent bills, and provide comment or expert testimony as needed.

**Assistance to Firefighters Grant (AFG) Program**

On November 18, 2009, H.R. 3791 (2009), the Fire Grants Reauthorization Act of 2009, was passed by the House. The legislation reauthorizes AFG and Staffing for Adequate Fire and Emergency Response (SAFER) programs through fiscal year 2014 and modifies the distribution of fire grant funds. The appropriations bill provided $810 million for firefighter assistance, including $390 million for AFG and $420 million for SAFER to help address a variety of equipment, training, and other firefighter-related and EMS needs. The OEHN could assist with grant writing to obtain AFG funds to be used to support or start an occupational health, wellness, and fitness program for firefighters.

**Resources and Partners**

The OEHN can influence the success of program implementation by using the full complement of resources available. There are many resources and
partners to provide helpful information regarding firefighter fatalities, standards, cardiovascular disease and its prevention, motor vehicle safety, and policy and procedure. Resources are also available to assist with health and fitness evaluations, health and wellness promotion, designing a fitness program, and education and training (see Appendices A and B for a listing of resources).
CHAPTER V

CONCLUSIONS/RECOMMENDATIONS

Implications for Future Research, Policy, and Practice

There are several future research topics that would provide useful and insightful information. First, little has been done to examine occupational health issues of women firefighters. Although women comprise only a small percentage of firefighters, their fatality rates are proportionally equal to men. CHD risk factors differ between men and women. Future research should examine the gender differences in firefighters to determine if there are differences in occupational risks. Knowing the gender specific risks of firefighters would allow for better targeting of interventions. Second, future research focusing on cardiovascular risks in firefighters is needed to validate the associations and implications in current research. The third key area is mental health. NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments does not include provisions for detecting, assessing, and managing mental health issues, and a mental health assessment is not part of the medical examination. Firefighters experience high levels of job-related psychological stress and there is little research about what kinds of mental health programs exist and issues surrounding accessibility and functionality of those programs. Other areas of future research should include:

- Evaluation of successful health and wellness programs;
- Job related obesity and its contributing factors;
- Applicability of the currently used BMI calculations;
• Firefighter culture;

• Behavior change; and

• Implications of instituting mandatory standards on the small, rural, and volunteer fire departments.

OEHNs should become active in the policy making and legislative process to help establish mandatory standards for initial medical screening and fitness standards, weight standards, annual medical examinations, and annual fitness evaluations. OEHNs can help create policies and programs that spotlight firefighter health, wellness and fitness as well as a safety culture which minimizes risk. Health, wellness, and fitness policies should particularly focus on decreasing CHD and CHD risk factors such as lack of physical fitness, obesity, poor nutrition, smoking, high blood pressure, and high cholesterol. Policies should also focus on motor vehicle safety.

Findings from current research and future research can help guide the direction of future policy and practice. Obvious barriers to implementing successful programs are cost, job security issues, confidentiality, and maintaining a critical number of staff in the small rural and volunteer fire departments and the OEHN can use research data to influence policy and implement necessary change. One firefighter death is one too many and now is the time to target efforts to reduce occupational fatalities in firefighters.
REFERENCES


APPENDICES

A. Firefighter Organizations/Resources .............................................. 70

B. Wellness/Resources ........................................................................ 72
APPENDIX A

FIREFIGHTER ORGANIZATIONS/RESOURCES

International Association of Fire Chiefs
4025 Fair Ridge Drive,
Suite 300
Fairfax, VA 22033-2868
Phone: (703) 273-0911
Fax: (703) 273-9363
Website: http://www.iafc.org

International Association of Firefighters
1750 New York Avenue, NW Suite 300
Washington, DC 20006-5395
Phone: (202) 737.8484
Fax: (202) 737-8418
Website: http://www.iaff.org

National Fallen Firefighters Foundation
PO Drawer 498
Emmitsburg, MD 21727
Phone: (301) 447-1365
Fax: (301) 447-1645
Website: http://www.firehero.org

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
Phone: (617) 770-3000
Fax: (617) 770-0700
Website: http://www.nfpa.org

National Institute for Occupational Safety and Health
4676 Columbia Parkway
Mailstop C14
Cincinnati, Ohio 45226
Toll-Free: (800) 35-NIOSH
Website: http://www.cdc.gov/niosh
National Volunteer Fire Council
1050 17th Street, NW
Suite 490
Washington, DC 20036
Toll-Free: (888)ASK-NVC
Phone: (202) 887-5700
Website: http://www.nvfc.org

United States Fire Administration
Federal Emergency Management Agency/DHS
16825 South Seton Avenue
Emmitsburg, MD 21727
Toll-Free: (800) 238-3358
Website: http://www.usfa.fema.gov
APPENDIX B
WELLNESS RESOURCES

American Council on Exercise
4851 Paramount Drive
San Diego, CA 92123
Toll-Free: (800) 253-4636, ext. 694
Website: http://www.acefitness.org

American Heart Association
7272 Greenville Ave
Dallas, TX 75231
Toll-Free: (800) 242-8721
Website: http://www.americanheart.org

Centers for Disease Control & Prevention
Cardiovascular Health Program
1600 Clinton Road
Atlanta, GA 30333
Phone: (404) 639-3311
Website: http://www.cdc.gov/cvh/

The Heart Healthy Firefighter Program
www.healthy-firefighter.org

Nutrition and fitness blog
www.firefighternation.com

Nutrition: Eat right, feel right
www.firerescue1.com/health