Heart to Heart: *Strategizing an Evidence-based Approach to Reduce Cardiac Disease and Death in the Fire Service*

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White paper

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Strategizing an Evidence-based Approach to Reduce Cardiac Disease and Death in the Fire Service

Findings and Recommendations from Heart to Heart: Strategizing an Evidence-based Approach to Reducing Cardiac Disease and Death in the Fire Service

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EXECUTIVE SUMMARY

The National Fallen Firefighters Foundation (NFFF) hosted a conference in Washington, D.C. in December 2015, to address cardiovascular disease in the fire service. This meeting was attended by more than 60 representatives of fire service constituency organizations, fire departments, and subject matter experts representing different fields of research associated with occupational health and cardiovascular health. Leading subject matter experts presented the current state of the science regarding heart disease-related death and disability in the fire service. These experts then worked together with fire service leaders in a consensus-building framework to identify recommendations to lessen cardiovascular events and to identify ways to transition scientific findings and best practices to the fire service **with the goal of increasing adoption of best practices for cardiovascular disease (CVD) prevention and treatment.** To make significant progress, participation and buy-in at all levels is essential. Therefore, this white paper presents specific targeted recommendations for different constituencies that will act to lessen the burden of cardiovascular disease within the fire service. A concerted effort is needed to implement these recommendations, but they are practical and attainable, and can be adopted using a phase-in approach.

Firefighters

Firefighters are ultimately the ones who must make the changes to reduce CVD in the fire service. Making these changes will require taking personal responsibility for one's health as well as adherence to organizational policy and procedures. Based on current understanding of research, to reduce their risk for CVD firefighters should:

1. Maintain a high level of physical fitness
2. Obtain an annual physical, even if it is not provided by the department
3. Routinely monitor blood pressure and control hypertension (if present)
4. Maintain or take actions to reach a healthy weight
5. Avoid tobacco use
6. Eat a healthy diet
7. Avoid excessive use of alcohol
8. Maintain normal lipid levels
9. Wear SCBA from initial attack to completion of overhaul
10. Get adequate sleep

"Because when we hit the fire ground, your risk factors become my risk factors."

–Firefighter Steve Mast

Fire Department – Company Officer/Crew Boss

Company officers/crew bosses have a position of great influence and should act as intermediaries to reinforce existing policies and facilitate policy change when needed. Company officers/crew bosses should talk with their members about

specific actions firefighters can take to reduce their risk of CVD, and should themselves serve as a role model for firefighters. Based on current understanding of research, company offers/crew bosses should:

1. Encourage high levels of fitness
2. Promote good nutrition
3. Reinforce the importance of knowing your CVD risk factor profile and working to improve it
4. Promote a tobacco-free lifestyle
5. Encourage a supportive environment for meeting health and fitness goals
6. Ensure the wearing of SCBA from initial attack to completion of overhaul

Fire Service Leadership – National Organizations

National organizations play a key role in promoting health and wellness in the fire service. These organizations influence legislation and policy decisions and set the national priorities for the fire service. Based on current understanding of research, it is recommended that fire service leaders take the following steps to prevent and manage CVD in the fire service:

1. Require pre-employment medical evaluations
2. Require annual medical evaluations
3. Require return-to-work evaluations
4. Implement physical fitness programs
5. Implement comprehensive wellness programs
6. Promote a tobacco-free workplace
7. Ensure that incident scene rehabilitation is established for emergency incidents and training drills

Our understanding of sudden cardiac events and cardiovascular disease in the fire service has increased tremendously over the past 15 years due to a shared sense of mission in reducing duty-related cardiac deaths by researchers, fire service representatives, and funding agencies. **But, knowledge alone cannot bring about the needed results. Action is required—the recommendations must be adopted and implemented. Adoption of the evidence-based recommendations in this report will help the fire service make significant strides toward reducing duty-related cardiac deaths, with a reduction of at least 30% within reach.**

BACKGROUND

More firefighters suffer duty-related deaths from cardiovascular disease (CVD) than any other identifiable cause. Over the past 11 years (2004–2014) nearly half (48%) of the nation's line-of-duty fatalities are attributed to heart attack (34). The second leading cause (trauma suffered at the scene) is a distant 25%. In addition to the lives cut short by CVD fatalities, there are approximately 17–25 non-fatal duty-related CVD events for every fatality (13). These non-fatal events can disrupt emergency operations, lead to early retirements, and inflict an enormous economic hardship on the department.

~50%

Percentage of firefighter line-of-duty fatalities attributed to heart attack or stroke.

Firefighting involves strenuous work that is performed in a hostile and toxic environment and it produces enormous physiological strain, particularly on the cardiovascular system (5,15,29). Sudden cardiac death is more likely to occur during or shortly after certain emergency duties, such as fire suppression, than during station duties, despite the fact that these emergency duties account for a relatively small proportion of firefighters' annual duties (17,18). Additionally, CVD events are most likely to occur in firefighters who possess an excess of traditional risk factors for cardiovascular disease along with underlying atherosclerosis and/or structural heart disease (8,18).

Due to the work of leading occupational health researchers, there is substantial documentation that firefighters have identifiable risk factors that are responsive to medical intervention (8,18,36). There is compelling evidence that improved screening and medical monitoring can help avoid the onset and impact of CVD, but the implementation of strategies to achieve this goal are currently hampered by a lack of communication between the medical providers who care for firefighters and the fire service. Steps must be taken to bridge this communication gap and improve firefighter health, because the percentage of CVD deaths has remained stubbornly high despite evidence that suggests duty-related CVD deaths can be decreased. Figure 1 presents firefighter fatalities between 2004 and 2014. It is evident that the total number of fatalities has decreased over time; however, the percentage of deaths caused by "heart attacks" has remained fairly constant.

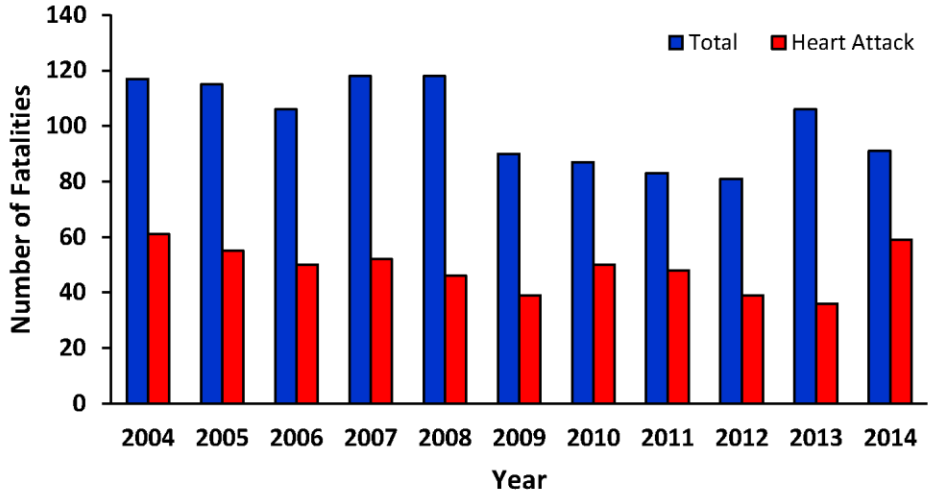

Figure 1. Firefighter fatalities between 2004 and 2004 (29).

Many duty-related CVD deaths can be prevented if firefighters have (a) proper screening; (b) the information they need to make life style changes provided in appropriate ways; and (c) medical evaluations performed by physicians who are knowledgeable about how firefighting impacts the development of cardiovascular conditions, and how it can serve as a triggering event in individuals with underlying cardiovascular disease.

The National Fallen Firefighters Foundation (NFFF) has emerged as a leading voice in occupational health and safety for the fire and emergency medical services industries. Chartered by Congress in 1992 to provide a resource for the survivors of firefighters who perished in the line of duty, its mission has since been expanded to include leadership in the prevention of firefighter fatalities and the enhancement of firefighter health and safety. The first national Firefighter Life Safety Summit was held in March 2004 in Tampa, FL. From that session emerged the 16 Firefighter Life Safety Initiatives (FLSI) designed to identify the essential challenges that needed to be addressed to reduce duty-related deaths. A second summit was held in February 2007, to review progress on the life safety initiatives and advance strategic directions for their further development, dissemination, and implementation. Prior to the meeting, a series of white papers was generated for each initiative to focus that effort and to guide the development of strategic plans for operationalization and implementation of each. In 2014, on the 10-year anniversary of the first summit, the NFFF convened TAMPA 2 to assess progress on the initiatives, determine whether the initiatives were still on target, and establish future directions (6).

The 16 Life Safety Initiatives have stimulated a variety of research, development, and standards making activity, including the National Fire Service Research Agenda (NRA) utilized by the Department of Homeland Security to guide its Research & Development grants under the Assistance to Firefighters Grants directive (7). This work has led to increased focus on the need to address health/medical issues in the fire service generally and cardiovascular health issues specifically (FLSI #2 and 6), as well as articulating the need for research to provide the foundation for this work (FLSI #7).

Firefighter Life Safety Initiatives

#2: Enhance the personal and organizational accountability for health and safety throughout the fire service.

#6: Develop and implement national medical and physical fitness standards that are equally applicable to all firefighters, based on the duties they are expected to perform.

#7: Create a national research agenda and data collection system that relates to the initiatives.

2015 Heart to Heart Conference

To address the issues related to cardiac death and disability in the fire service, the NFFF hosted the Heart to Heart conference in December 2015, in Washington, D.C. More than 60 representatives of fire service constituency organizations, fire departments, and subject matter experts representing different fields of research associated with occupational health and cardiovascular health participated in the conference (see complete list of participants and affiliations in Appendix A). The goal of this conference was to present fire service leadership with the most up-to-date research findings and identify targeted dissemination methodologies and evaluation mechanisms for determining the effectiveness of these efforts.

The objectives of the 2015 Heart to Heart conference were to:

1) Gather researchers from the scientific and medical research communities to present the state of knowledge regarding heart disease in firefighters and the risk it presents to public safety in a manner accessible to fire service leadership;

2) Develop strategies for introducing and supporting evidence-based knowledge into the fire service by bringing together leadership, researchers, and occupational medicine specialists concerned about firefighter health, safety, and performance;
3) Develop broad strategies for translating current understanding of research to recommendations that the fire service can champion in the areas of medical evaluations, fitness goals, and behavioral health changes. Each of these areas will build on current efforts within the fire service, but will be expanded to include new scientific information, and will be approached with the perspective that we must increase the accessibility of the information by individual firefighters;
4) Lay the groundwork for an after-conference white paper to better articulate and refine the broad strategies outlined above. The white paper stressing attainable and practical solutions will be widely circulated throughout the fire service.

The first day of the conference featured structured presentations covering a statistical profile of cardiovascular-related firefighter line-of-duty deaths and the state of the science from key researchers and practitioners. Presenters who updated the group on the state of the science relative to cardiovascular disease are listed below.

Denise Smith, Ph.D. (Principal Investigator)

Dr. Smith is a Professor of Health and Exercise Sciences at Skidmore College where she serves as Director of the First Responder Health and Safety Laboratory. She also holds an appointment as a Research Scientist at the University of Illinois Fire Service Institute. Dr. Smith's primary area of research is cardiovascular health, with a specific focus on the relationship between heat stress and cardiovascular function. A significant portion of her research focuses on the cardiovascular strain associated with firefighting activity. She has published several articles on the effects of firefighting on cardiovascular function, coagulatory potential, immune function and hormonal status, and has led several government-funded studies to investigate strategies to minimize the physiological strain associated with firefighting. Professor Smith has also conducted several laboratory studies designed to identify specific components of firefighting activity (work performed, heat stress, sympathetic nervous stimulation) that are responsible for specific

physiological responses to the combined stress of firefighting, including one currently underway for the National Fallen Firefighters Foundation.

Stefanos N. Kales, M.D., MPH, FACP, FACOEM

Dr. Kales holds his Doctor of Medicine degree from Harvard Medical School, where he is Associate Professor of Medicine, and a Master of Public Health degree from the Harvard T.H. Chan School of Public Health, where he is an Associate Professor and Director of the Occupational Medicine Residency. He also serves the Division Chief OEM for Cambridge Health Alliance, a Harvard Teaching Affiliate. Dr. Kales is widely recognized as one of the primary investigators concerning the relationship between cardiovascular disease and the profession of firefighting. His group has performed the most extensive collection of epidemiologic studies identifying both occupational and medical risk factors for cardiovascular disease events among first responders, including original investigations of sudden cardiac death published in the *New England Journal of Medicine* and the *British Medical Journal*. His areas of specialization are CVD risk factors, epidemiology and occupational health.

Sara Jahnke, Ph.D.

Dr. Jahnke holds a Ph.D. in Counseling Psychology, Health Emphasis from the University of Missouri-Kansas City. Since 2009, she has served as Principal Investigator for the National Development and Research Institutes, specializing in Fire Rescue and EMS Health Research. Her work in the field of culture, behavior, and disease is greatly influencing how health messaging is seeded in the fire service.

Steven Moffat, M.D.

Dr. Moffat is a highly respected Occupational Medical physician for the Emergency Response community. He was a founding member of the IAFF/IAFC Wellness-Fitness Task Force, and is a member of the NFPA 1582 Technical Committee and NIOSH Firefighter Cardiovascular Mortality Study Advisory Board. The relationship between Occupational Medical physicians and fire departments is an emerging area of study, with Dr. Moffat at the forefront of that effort.

Kevin Roche, Meeting Facilitator

Mr. Roche has over 30 years of service as a firefighter, fire department administrator, and consultant to fire service organizations, fire departments, and industry. He is a consultant to the NFFF having served as the Principal Investigator for the USFA/NFFF Line-of-Duty Death Annual Reports. At this meeting he presented four case studies relating to firefighters who had died in the line-of-duty due to cardiac-related diseases.

The conference was hosted by the NFFF. The leadership team responsible for the organization and administration of the conference is listed below:

Conference Leadership:

Ronald J. Siarnicki, Executive Director, NFFF
Denise Smith, Ph.D., Skidmore College and the Illinois Fire Service Institute
Victor Stagnaro, Director of Fire Service Programs, NFFF
JoEllen L. Kelly, Ph.D., Director of Research, Everyone Goes Home® Program

Contributing greatly to the motivation of the conference and adding immeasurably to the success of the event were two survivors who shared their personal story.

Linda Abriel, LPN, NFFF Line-of-Duty Death Survivor
Steve Tullis, Firefighter/Paramedic, Hinsdale (IL) Fire Department/ NFFF Line-of-Duty Survivor

The first day of the conference included presentations by leading scientists and clinicians who presented state-of-the science presentations regarding CVD in the fire service:

"Cardiac Strain and Sudden Cardiac Events" by Dr. Denise L. Smith
"Cardiovascular Health of Firefighters and Cardiovascular Risk Factors and Associated Risk" by Dr. Stefanos N. Kales
"How Health Behaviors Contribute to LODDs" by Dr. Sara A. Jahnke
"The Fire Service – The Need for a Higher Standard of Care" by Dr. Steven M. Moffat
"National Fallen Firefighters Foundation Line-of-Duty Death Analysis" by Mr. Kevin Roche

During the first day, case studies pertaining to CVD-related line-of-duty death were reviewed and there was a kitchen-table style discussion led by fire chiefs

and representatives from national fire service organizations. The second day of the conference was devoted to identifying ways to transition scientific findings and best practices to the fire service with the goal of increasing adoption of best practices for CVD prevention and treatment. The facilitated discussions included three major topics known to be critical to lessening cardiovascular disease in the fire service: medical evaluations, fitness and wellness, and behavioral health related to cardiovascular disease. Then breakout groups generated broad strategies for introducing and supporting recommendations targeted at reducing CVD and duty-related cardiac deaths in the fire service (see Appendix B) using best-fit approaches with respect to fire service programs and practices.

This white paper summarizes the major points from the presentations and discussions. Additionally, and perhaps more importantly, **the paper presents attainable and practical solutions to improve firefighter health and safety targeted to fire service leadership, company-level officers, and individual firefighters. Frequently used abbreviations and a glossary of terms are provided to assist the reader.**

Commonly Used Abbreviations

BMI, body mass index
CHD, coronary heart disease
CVD, cardiovascular disease
LVH, left ventricular hypertrophy
LDL, low-density lipoprotein
HDL, high-density lipoprotein
METs, metabolic equivalents
PPE, personal protective equipment
SCD, sudden cardiac death
SCE, sudden cardiac event

Glossary of Terms

Arrhythmia – irregular heart beat.

Cardiomegaly – a general term used to describe an enlarged heart; can be caused by various conditions, but oftentimes associated with hypertension and coronary artery disease.

Coronary heart disease (CHD) – a narrowing of the blood vessels that supply blood and oxygen to the heart tissue; often called coronary artery disease (CAD).

Cardiovascular strain – the physiological response of the cardiovascular system to exercise or physical work.

Heart attack – also known as myocardial infarction; occurs when blood vessels become blocked preventing the blood supply from reaching the heart.

Left ventricular hypertrophy – a thickening of the heart muscle surrounding the left ventricle, resulting in a greater mass of the heart.

Metabolic equivalent – measure used to express the energy cost of physical activities, where 1 MET is defined as the energy cost of sitting quietly (3.5 mL/kg/min).

Odds Ratio – number that represents the odds or probability that an outcome will occur given a particular exposure (e.g., hypertension) compared with the odds of the outcome occurring in the absence of that exposure.

Physiological strain – how the body responds to exercise or physical work.

Plasma volume – the total volume of plasma in the body (not including blood particles).

Susceptible individuals – those at risk for CVD events.

Stroke volume – the volume of blood pumped out of the left ventricle during each heart beat.

Sudden cardiac event – an unexpected cardiovascular event (stroke, heart attack, heart arrhythmia) that occurs suddenly in a person with or without diagnosed cardiovascular disease. This event may or may not result in death.

Ventricular tachycardia – a heart rhythm that originates in the ventricles and produces a heart rate of at least 120 beats per minute.

Ventricular fibrillation – uncoordinated series of very rapid, ineffective contractions of the ventricles caused by many chaotic electrical impulses; potentially fatal due to the inability of the heart to pump blood to the body.

CARDIOVASCULAR STRAIN OF FIREFIGHTING

Firefighting involves strenuous work while wearing heavy, insulating personal protective equipment (PPE) and operating in a hot and dangerous environment. The high physical demands of firefighting result in the placement of substantial physiological strain on most systems of the body, particularly the cardiovascular system (5,15,29). The increased cardiovascular strain of firefighting begins with the sound of the alarm bell, which leads to activation of the sympathetic nervous system and the release of adrenaline, resulting in increases in heart rate and blood pressure. On scene, the performance of strenuous firefighting tasks such as climbing stairs and ladders, advancing charged hose lines, performing forcible entry, and searching for victims while wearing heavy (>50 lb), encapsulating PPE further stresses the cardiovascular system. As operations progress, increases in core temperature and profuse sweating, which may lead to dehydration, place even greater strain on the cardiovascular system. Environmental conditions including, heat, noise, and smoke also contribute to cardiovascular strain. Additionally, a firefighter's individual characteristics, such as health status, physical fitness level, and hydration status influence cardiovascular strain. Ultimately, the magnitude of cardiovascular strain experienced by a firefighter depends on the interaction of environmental factors and personal factors as shown in Figure 2.

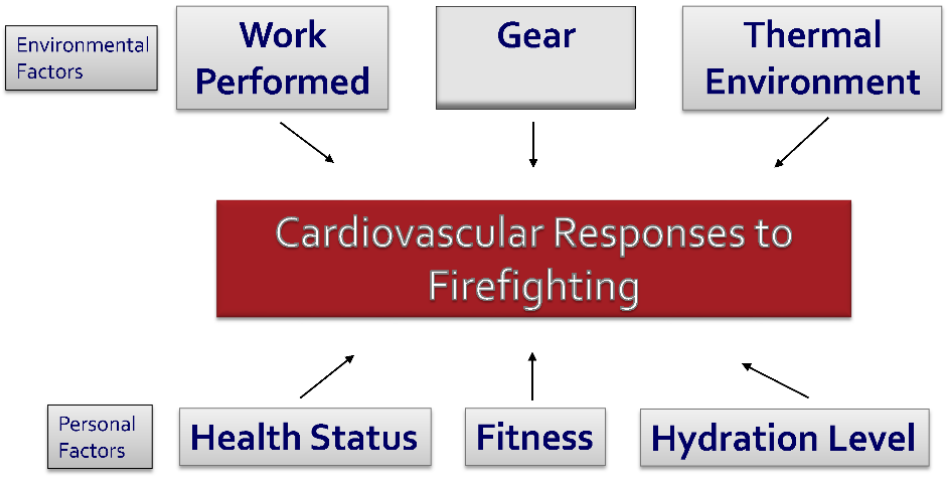

Figure 2. Factors affecting the cardiovascular strain of firefighting. Modified from Haigh and Smith (12).

Many physiological responses contribute to the cardiovascular strain associated with firefighting. Research indicates that firefighting results in increased cardiovascular strain as evidenced by:

- Near maximal to maximal heart rate (15,29);
- An increase in systolic blood pressure (1);
- A decrease in stroke volume (5,29);
- Evidence of diastolic dysfunction (5);
- A reduction in plasma volume (30);
- An increase in platelet function and clotting potential (28,31); and
- An increase in vascular stiffness (stiffness of the arteries) (3).

Results from research studies confirm what firefighters know well from experience—firefighting is strenuous work that imposes substantial cardiovascular strain. Most firefighters recover from the cardiovascular strain of firefighting without incident; however, in some susceptible firefighters these physiological changes may lead to a sudden cardiac event.

SUDDEN CARDIAC EVENTS IN THE FIRE SERVICE

Between 2005 and 2014, 485 firefighter line-of-duty deaths were caused by sudden cardiac death. Sudden cardiac death accounted for 39% to 64% of all line-of-duty fatalities annually and 48% of deaths over this period. Members of every classification (career, volunteer, wildland), all ranks, both sexes, and a wide range of ages were victims. The median age of firefighters who succumbed to SCD was 53 years, with the youngest firefighter only 19 years of age and the oldest nearly 87. When grouped by classification, the median age of death was younger for career than volunteer firefighters (48 years versus 55 years). Based on superficial statistics, it may appear that SCD is likely to strike any firefighter, but the risk of sudden cardiac death is not distributed equally or at random within the fire service or over time. On the contrary, research has definitively shown that specific job duties put a firefighter at increased risk of sudden cardiac death, and that the vast majority of SCD events occur among susceptible firefighters with an excess of CVD risk factors or a previous diagnosis of CVD.

Type of Duty

Several studies have provided compelling evidence that strenuous firefighting activities can trigger sudden cardiac events in susceptible firefighters (14,17,18). The largest of these studies investigated 449 line-of-duty deaths

attributed to coronary heart disease (CHD) that occurred between 1994 and 2004 (17). The researchers used several sources to estimate the average proportion of time spent performing different firefighting duties. Results indicated that fire suppression represented only a small portion (1–5%) of firefighters' professional time but accounted for 32% of CHD deaths. When expressed in terms of statistical measures, the odds of death from CHD were approximately 53 times higher during fire suppression compared with fire station duties. As illustrated in Figure 3, compared with non-emergency (fire station and other), odds of death were markedly higher during fire suppression than any other duty. Notably, strenuous fire suppression tasks were associated with much greater odds of CHD-related death than physical training, which suggests that the added environmental and emotional stressors of firefighting contribute to the increased risk of death during fire suppression.

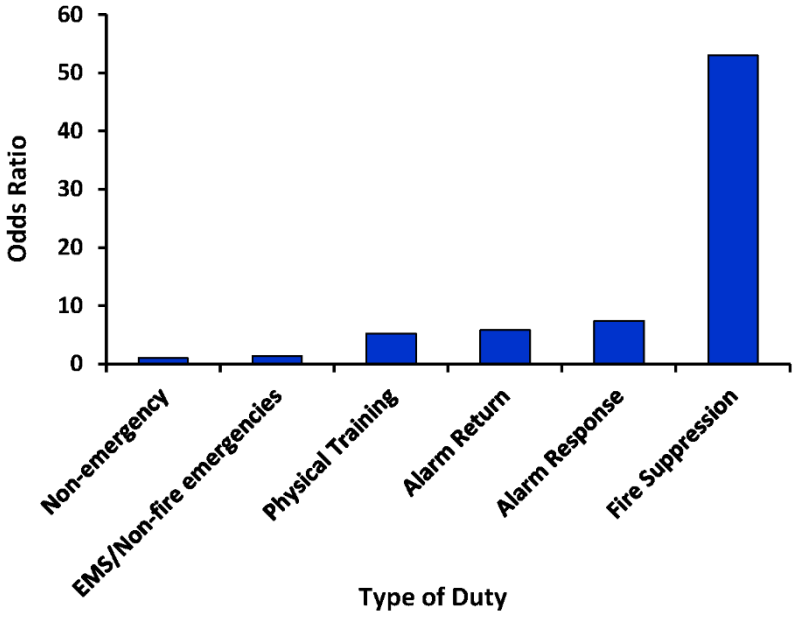

Figure 3. Risk of line-of-duty coronary heart disease-related deaths by type of duty. Modified from Kales et al. (17).

56%

Percentage of SCD fatalities with LVH on autopsy

LVH is an independent predictor of SCD

Underlying Cardiovascular Disease

Studies have shown that duty-related sudden cardiac events occur almost exclusively in firefighters who have an excess of traditional CVD risk factors and some type of underlying structural heart disease (8,14,18,36). Autopsies on firefighters who succumbed to SCD have shown CHD to be a major contributing factor in SCD fatalities. Furthermore, these autopsies frequently revealed left ventricular hypertrophy (LVH; a thickening of the heart muscle surrounding the left ventricle) and/or cardiomegaly (an enlarged heart). In one study, 56% of

firefighters who succumbed to SCD had LVH based on autopsy (8). In a group of young firefighters (≤45 years), cardiomegaly was found in 66% of SCD victims and it was associated with a 5-fold increased risk of SCD (36). Studies have also reported that 25–30% of CHD-related fatalities occurred in firefighters with diagnosed CHD or a clinical equivalent (e.g., peripheral vascular disease, carotid stenosis, myocardial infarction, etc.). In cases with prior CHD, the median time from initial diagnosis to the final event (fatality/retirement) was approximately 3.5 years, and during this time there were often secondary events.

Theoretical Model for Sudden Cardiac Events in the Fire Service

Sudden cardiac events in firefighters most likely result from the interaction of multiple stressors in susceptible firefighters with preexisting cardiomegaly/LVH or and or underlying CHD (27). Figure 4 presents a theoretical model that links the cardiovascular strain (cardiac, vascular and hematological responses) of firefighting with the triggering of sudden cardiac deaths. Row A depicts the interrelated cardiovascular changes known to occur with fighting activities, including increases in heart rate and blood pressure, decreased plasma volume as a result of profuse sweating, changes in vascular function, and an increase in coagulatory potential.

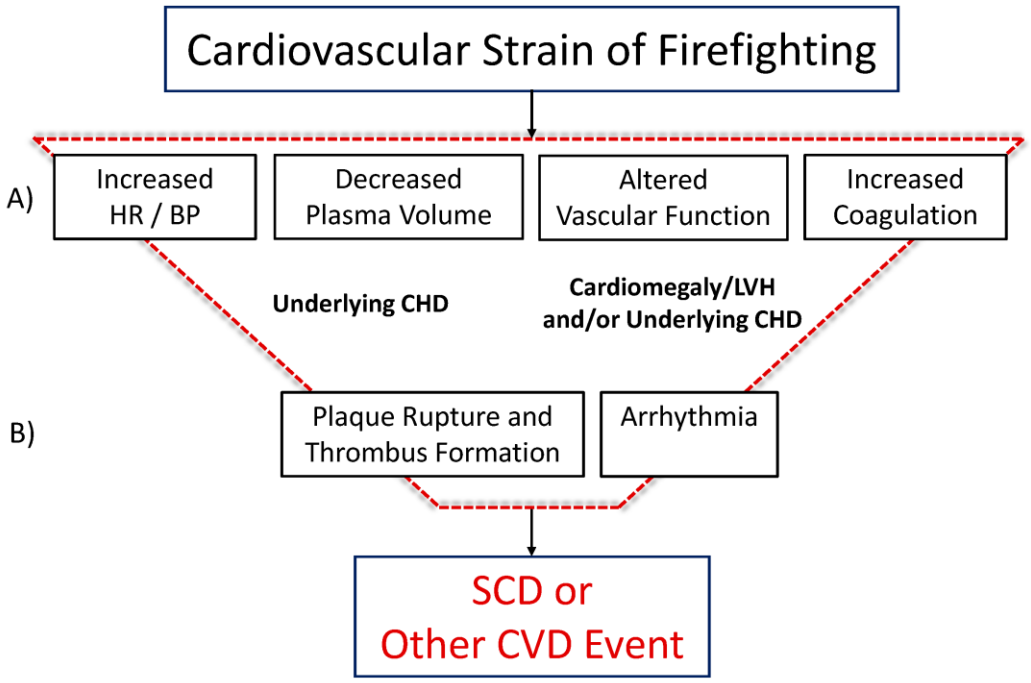

Figure 4. Theoretical model depicting the relationship between the cardiovascular strain of firefighting and line-of-duty sudden cardiac events. Modified from Smith et al. (27).

This model acknowledges that physiological changes may range from moderate to severe depending on environmental factors (work performed, gear, thermal stress) and individual factors (health status, physical fitness level, and hydration level), but they do not generally pose a high risk in healthy individuals. However, in firefighters with underlying structural cardiovascular disease (CHD and/or cardiomegaly/LVH), firefighting may lead to pathological changes that increase the risk of plaque rupture and thrombus formation and/or arrhythmia (Row B), which may lead to sudden cardiac death or a non-fatal cardiac event. **Thus, firefighting may serve as a trigger for sudden cardiac events in susceptible firefighters.**

Although the cause of CVD events in the fire service is often assumed to be myocardial infarction (heart attack), as shown in Row B of Figure 4, cardiac events could also be caused by primary ventricular arrhythmia (e.g., ventricular tachycardia or ventricular fibrillation) (27). CHD increases the risk of both myocardial infarction and arrhythmia.

Myocardial infarction. A myocardial infarction occurs when a coronary artery becomes blocked, reducing blood flow to the heart muscle and causing death or damage. CHD is a narrowing of the coronary arteries due to the buildup of atherosclerotic plaque. Increased heart rate and blood pressure during firefighting increases the risk of plaque rupture in the coronary arteries. Plaque rupture stimulates the formation of a blood clot (thrombus), and if the clot becomes large enough, it can severely limit or completely block flow through the artery leading to a myocardial infarction. The coagulatory changes associated with firefighting, particularly within a short time after firefighting, may make thrombus formation more likely.

Arrhythmia. An arrhythmia is an abnormal transfer of current through the heart's conduction system. Frequently an abnormal area of cardiac tissue, such as ischemic tissue, acts as a focus for the irregular conduction. Strenuous activity such as firefighting places increased demand on the heart. Insufficient blood flow and oxygen delivery to cardiac tissue as a result of CHD may lead to areas of ischemic tissue and an increased risk of arrhythmia. Additionally, cardiomegaly and LVH are both structural abnormalities of the heart that increase the risk of arrhythmia. Particulate matter found in fire smoke is also associated with an increased risk of arrhythmia, which may be more likely to strike firefighters with underlying structural disease.

CARDIOVASCULAR DISEASE RISK FACTORS

CHD develops over many years, typically decades. Importantly, many of the risk factors for developing CHD are modifiable; therefore, firefighters can assert some control over the progression of atherosclerosis. Traditional modifiable risk factors include high LDL cholesterol, high triglycerides, high blood pressure, diabetes and pre-diabetes, overweight and obesity, smoking, lack of physical activity, unhealthy diet, and stress. These risk factors are included in a theoretical model that depicts the interaction of occupational, behavioral, and medical risk factors or exposures that influence the development of cardiovascular disease (Figure 5) (33). Note that many occupational and behavioral risk factors overlap, and that risk factors or exposures may favorably or negatively influence the progression of atherosclerosis and development of heart disease. The next sections describe the prevalence of these risk factors or exposures and the risk associated with each factor or exposure.

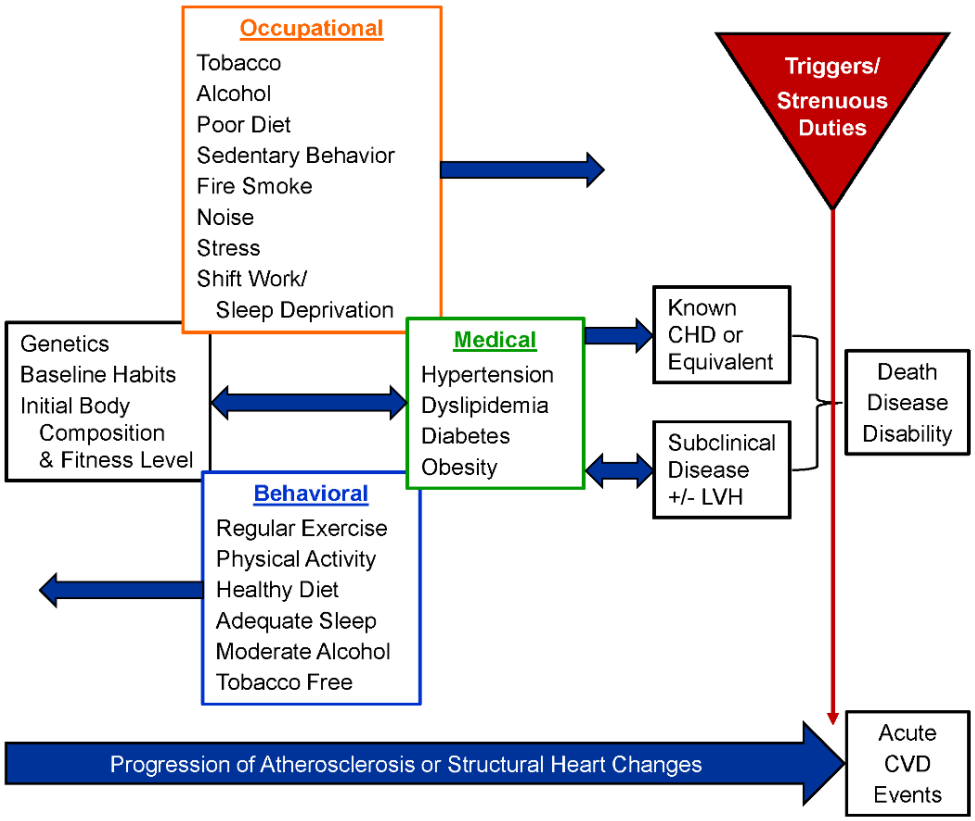

Figure 5. Theoretical model of occupational, behavioral, and medical risk factors or exposures that contribute to cardiovascular events in the fire service. Modified from Soteriades at al. (33).

CVD Risk Factors

- Non-modifiable:
  - Age
  - Sex
  - Family history
- Modifiable:
  - Hypertension
  - Overweight/ Obesity
  - Dyslipidemia
  - Diabetes
  - Physical inactivity
  - Smoking

Medical Risk Factors

Hypertension

Hypertension is a well-established risk factor for CVD, with increasing risk beginning in the prehypertension stage. Table 1 defines normal and high blood pressure severity levels; the increased risk of CVD associated with hypertension is presented in the box below the table.

Table 1. Classification of Blood Pressure (BP).

Category	Systolic BP (mmHg)		Diastolic BP (mmHg)
Normal	<120	and	<80
Prehypertension	120–139	or	80–89
Hypertension, Stage 1	140–159	or	90–99
Hypertension, Stage 2	≥160	or	≥100

Increased Risk of CVD Associated with Hypertension

For individuals 40–70 years of age, beginning in prehypertension (SBP ≥120 mm Hg; DBP ≥80 mm Hg) the risk of CVD **doubles** for every incremental rise of:

- 20 mm Hg SBP
- 10 mm Hg DBP

Source: National Heart, Lung, and Blood Institute (23)

>50%
Percentage of firefighters with prehypertension

~20%
Percentage of firefighters with hypertension

Approximately 20% of firefighters have hypertension and this number is expected to increase due to increasing rates of obesity (4,19). Furthermore, more than 50% of firefighters have prehypertension (19). **Firefighter fatality studies have shown that uncontrolled hypertension is associated with approximately a 12-fold increase in death** (17). Hypertension is also associated with other adverse employment outcomes including disability retirements and nonfatal myocardial infarction (14). Evidence suggests that firefighters with uncontrolled hypertension are more likely to suffer adverse job outcomes than firefighters with controlled hypertension. Nevertheless, blood pressure need not be extremely high to warrant concern, because the majority of CVD events that occur in emergency responders occur in individuals who are only mildly hypertensive or prehypertensive (e.g., 140/92 mm Hg) (19). Additionally, hypertension is a major cause of LVH, which is associated with increased cardiovascular risk.

Overweight and Obesity

Overweight and obesity are well-known risk factors for CVD. Definitions of overweight and obesity based on BMI (weight in kilograms divided by the square of the height in meters) are provided in Table 2.

Table 2. Classification of Overweight and Obesity by Body Mass Index.

Category	Body Mass Index (kg/m^2)
Underweight	<18.5
Normal	18.5–24.9
Overweight	25.0–29.9
Obesity	≥30.0

As shown in Figure 6, BMI has been increasing steadily over time within the fire service (33). By the late 1990s, mean BMI had increased to approximately 29 kg/m^2 among firefighters 30 years of age and older. Even young firefighters (23–29 years of age) had an average BMI greater than 28 kg/m^2.

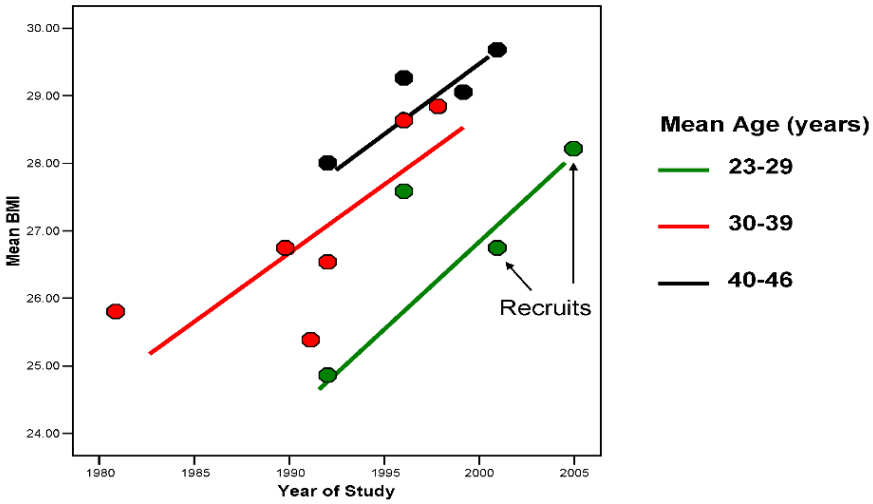

Figure 6. Mean body mass index (BMI) in different age groups from representative studies of firefighters 1980–2005. Reprinted with permission from Soteriades et al. (33).

Recent studies indicate that obesity and overweight continue to be a concern in the fire service. **In a recent study of 677 firefighters, the combined prevalence of overweight and obesity was nearly 80% among both career and volunteer firefighters, with 34% of career and 43% of volunteer firefighters being obese (25).** Obesity is associated with an increased risk of non-CHD retirement and on-duty CHD death. As seen in Figure 7, the odds of CHD duty-related death for obese firefighters were about 3 times those of non-obese firefighters (33).

30-45%
Percentage of firefighters who are obese

~80%
Percentage of firefighters who are overweight or obese

In addition to increased risk of duty-related CHD death and disability, obesity is associated with an increased risk of injury (16). In a group of 433 firefighters, the number of workers compensations claims were nearly 300% greater for obese firefighters compared with firefighters with a normal BMI (21). Substantially elevated risks of disability (32) and non-CHD retirement (14) have also been reported among obese firefighters (see box below).

Job-related Consequences of Obesity

≈**300% increase:** Workers compensation claim (21)

60–90% increase: Disability risk (compared with normal BMI) (32)

≈**300% increase:** Non-CHD retirement (14)

Dyslipidemia

Dyslipidemia is a condition of unhealthy lipid (fat) levels in the blood and can include a high level of total cholesterol, low-density lipoprotein (LDL, the "bad" cholesterol), or triglycerides or a low level of high-density lipoprotein (HDL, the "good" cholesterol). Classification of total cholesterol and triglycerides are provided in Table 3.

Table 3. Classification of Total Cholesterol and Triglycerides used in the Diagnosis of Dyslipidemia.

Lipid Classification	Level (mg/dL)
Total Cholesterol	
Desirable	<200
Borderline high	200–239
High	≥240
Triglycerides	
Normal	<150
Borderline high	150–199
High	200–499
Very high	≥500

More than 20% of firefighters have high levels of triglycerides, whereas approximately 30% of firefighters had low levels of HDL. As seen in Figure 7, high total cholesterol has been found to be associated with a 4.4-fold increased risk of on-duty CHD death.

4.4

Odds ratio for high total cholesterol and risk of on-duty CHD death

Diabetes Mellitus (Type II)

Diabetes mellitus is a metabolic disease characterized by the inability to use glucose (sugar) effectively due to deficiencies in (Type I) or resistance to (Type II) insulin (a hormone that helps transport glucose from the blood stream into the cells of the body. Diabetes is defined using the criteria listed in Table 4.

Table 4. Classification of Type II Diabetes Mellitus.

Variable	Value
Fasting blood glucose	≥126 mg/dL
Hemoglobin A1C	≥6.5%
Oral glucose tolerance test	≥200 mg/dL

The prevalence of diabetes in firefighters is only 3%; however, among firefighters who suffered on duty-CHD events, the prevalence was greater than 20% (18). **As seen in Figure 7, diabetes is associated with approximately a 10-fold increased risk of CHD-related death in firefighters (18).**

Summary

Not surprisingly, medical risk factors for CVD are associated with an increased risk of CHD-related death in firefighters as illustrated in Figure 7. The increased odds of death range from 3 to 12, with hypertension associated with the greatest risk of CHD-related death. However, by far the strongest predictor of CHD-related death, with a striking 35-fold increased risk, is prior diagnosis of CHD (e.g., peripheral vascular disease, carotid stenosis, myocardial infarction) (17).

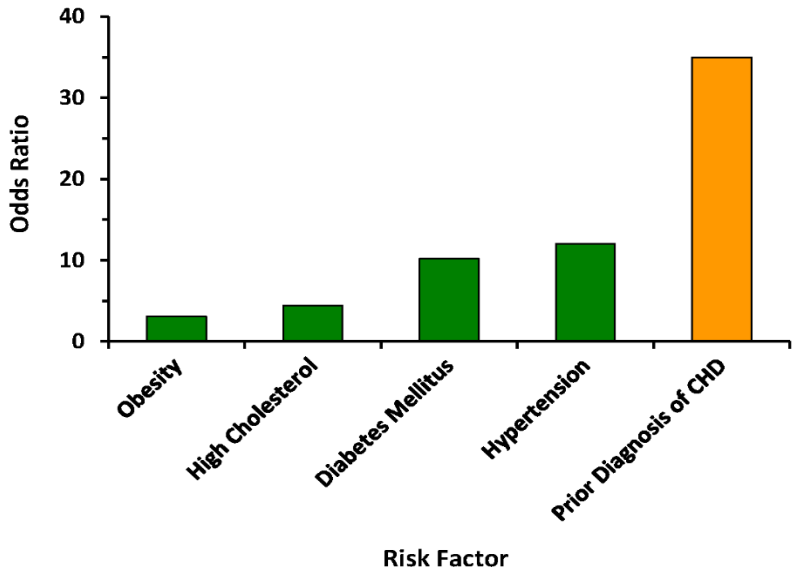

Figure 7. Risk of line-of-duty coronary heart disease-related deaths by cardiovascular disease risk factor. Modified from Kales et al. (17).

Occupational and Behavioral Risk Factors or Exposures

As shown in Figure 5, occupational risk factors or exposures may increase the progression of atherosclerosis and risk of CVD; however, **the substitution of good behaviors for poor ones can improve a firefighter's CVD risk profile**.

Top 3 Behavioral Risk Factors:

- Tobacco Use
- Sedentary Lifestyle
- Poor Nutrition Habits

These risk factors can lead to:

- Development of medical risk factors
- Acceleration of medical risk factors

Tobacco Use

Smoking is a major risk factor for CVD and harms nearly every organ in the body. Yet, despite overwhelming evidence that smoking is detrimental to one's health, roughly 15% of firefighters report being a current smoker (10). Between 40% and 50% of the firefighters who succumbed to a CHD-related fatality were smokers (8,18). Smoking is associated with approximately a 9-fold increase in the risk of duty-related CHD death (18). Thus, being a current smoker in and of itself increases the risk of CHD-related death. In addition to the well-established role of smoking as a risk factor for CVD and cancer, smoking is associated with other significant health and safety risks. In a large study of 677 firefighters, current smokers were almost 6 times more likely to report having an anxiety disorder, 3 times more likely to report problem drinking, and 5 times more likely to report driving while intoxicated (10).

There has been a gradual shift in the fire service culture toward a tobacco free workplace and workforce. In part, this has been achieved through regulations such as no tobacco use contracts, indoor smoking laws, and disease presumption laws. Additionally, the shift toward non-smoking could be attributed to a number of factors that are not policy related: recognition that smoking decreases readiness to perform the job, heightened awareness of the medical consequences, witnessing the end result of smoking on calls, and the economic cost. Some firefighters may use smokeless tobacco as an alternative to smoking. The rates of smokeless tobacco use are considerably higher in firefighters compared with adult men in the US (~17% versus 7%) (10). Smokeless tobacco has been associated with an

Definitions of Heavy Drinking and Binge Drinking

Heavy drinking

Men: >2 drinks/day (≥15/week)

Women: >1 drink/day (≥8/week)

Binge drinking

Men: >5 drinks within 2 hours

Women: >4 drinks within 2 hours

Standard drink:

12 oz.

5 oz.

1.5 oz.

increased risk of death from heart attack and stroke and increased risk of some cancers (particularly oral cancer).

Alcohol

Excessive use of alcohol is associated with a number of negative health outcomes including, cardiovascular disorders and other diseases, accidental injuries, violence, sleep disruption, and increased risk of mortality. A large study has reported that approximately 50% of firefighters were heavy drinkers (9). Furthermore, binge drinking was reported by roughly 50% of firefighters. Some proposed reasons for excessive alcohol use are the shift schedule (leaves a lot of days with no work the next day), camaraderie, stress management (helps to "wind down"), and tradition.

Poor Dietary Habits

Fire service culture contributes to the poor dietary habits associated with the high levels of obesity and overweight and dyslipidemia in the fire service. The nutrition environment in the firehouse often reinforces poor eating habits and unhealthy nutrition through a combination of irregular eating patterns, large portions sizes, meal planning (cost versus health), and traditions such as using meals as bonding, and diets high in processed carbohydrates and sugar. Data indicate that the top six sources of calories, in decreasing order, are alcohol, chips/pretzels, potatoes, nuts, milk, and sugary beverages. However, this need not be the case, and there are numerous examples of crews, shifts, and departments working together to change the culture of the fire station to be one of healthy eating.

Physical Inactivity

Although firefighting is strenuous work, firefighters experience long periods of sedentary behavior or time spent in low-intensity activities. Physical inactivity is a major risk factor for cardiovascular disease, whereas regular moderate-intensity (or greater) aerobic activity is associated with numerous health benefits. The risks of CHD or CVD decrease dramatically with increasing levels of physical activity and cardiorespiratory fitness. In terms of CVD risk reduction as well as job performance, physical fitness is paramount.

Fitness

Each 1 additional MET of improved fitness level conveys:

- 13% decrease in all-cause mortality
- 15% decrease in CV events

Source: Kodama et al. (20)

Fitness is strongly associated with cardiovascular health in firefighters. Even simple measures of fitness are associated with important health outcomes. For example, the probability of a major cardiac event was significantly greater for firefighters who completed ≤20 pushups compared with those who were able to complete >20 pushups.

Many national organizations emphasize health/fitness programs in the fire service; nevertheless, 70% of fire departments do not have the need for a formal fitness program. Additionally, most departments do not require incumbent firefighters to meet fitness performance standards; thus, there may be insufficient impetus for firefighters to use their discretionary time to exercise. Furthermore, overtime or second jobs may reduce the amount of off-duty time available for exercise.

Shift Work/Sleep Deprivation

Extended shifts, night shifts, and overtime are associated with in increased risk for negative cardiovascular outcomes, obesity, type II diabetes, sleep disturbances, and injuries. Furthermore, sleep deprivation can impair job performance through decreased reaction time and accuracy, fatigue, cognitive impairment, and hallucinations. However, in a group of 458 firefighters, the rate of excessive

Benefits of fitness:

↑ Work capacity

↑ Cardiac efficiency

↑ Muscular strength/ endurance

↓ Fatigue

↑ Thermal tolerance

↑ Plasma volume

Improved clotting profile

daytime sleepiness in firefighters was similar to or lower than rates in the general population and shift-working occupations, which included police, physicians, and industrial plant workers (11). Firefighters with excessive daytime sleepiness were more likely to have worked a 48-hour shift, used a shared sleeping area in the department, and worked a second job outside the fire service. In general, firefighters might not be at increased risk for excessive daytime sleepiness because they do not typically "work" the whole time they are on shift because they are allowed to sleep at night while on duty. Private quarters or sleep promoting environments may be beneficial for the small percentage of firefighters who report excessive daytime sleepiness.

Fire Smoke

Fire smoke exposure has been significantly reduced through the mandated use of self-contained breathing apparatus during fire suppression. However, during operations such as size-up, venting, pumping, and command, firefighters continue to be exposed to fire smoke. Also, too many firefighters still remove their mask during overhaul despite evidence of high particulate matter during this phase. Fire smoke contains toxic gases that cause reactions within the body that may lead to tissue hypoxemia and myocardial ischemia in susceptible firefighters. Fire smoke also contains particulate matter, which has been associated with the promotion of arrhythmias, increased blood pressure, and decreased heart rate variability (2,22). Particulate matter may also play a role in the accelerated progression of atherosclerosis.

Noise

Alarms, sirens, and mechanical equipment are sources of intermittent noise during a shift. Noise negatively affects the cardiovascular system through increases in blood pressure. It has been estimated that for every 5 decibel increase in acute occupational noise exposure, there is an increase of 0.5 mm Hg in systolic blood pressure (35). Consequently, there is a potential increase of 6 to 12 mmHg with siren noise.

Psychological Stress

Firefighters are frequently exposed to trauma and a variety of psychological stressors during emergencies. Although rates differ among studies, evidence suggests that firefighters have an increased risk of behavioral health issues such as post-traumatic stress disorder, depression, anxiety, and sleep disturbances. These

health issues may be associated with adverse effects on the cardiovascular and metabolic systems.

Summary

As illustrated in Figure 5, there are a host of occupational and individual risk factors that directly affect cardiovascular health. These risk factors can lead to the development or acceleration of medical risk factors. Importantly, behaviors can be altered to create a more favorable CVD risk profile. Regular exercise, adequate physical activity, a healthy diet, adequate sleep, moderate alcohol use, and being tobacco free are positive factors that can reduce the risk of developing cardiovascular disease. In fact, it is largely through addressing these behavioral risk factors and encouraging positive behavior that the fire service can improve cardiovascular health and lessen cardiovascular disease and death.

Behaviors to Improve Cardiovascular Health

- Regular exercise
- Adequate physical activity
- Healthy diet
- Adequate sleep
- Moderate alcohol use
- Being tobacco free

MANAGEMENT OF CVD RISK IN THE FIRE SERVICE

The prevention and management of CVD risk among firefighters is crucial to decreasing line-of-duty deaths. Although firefighters must take an active role in reducing their risk for CVD, the fire service must take action on a national level to protect its most valuable asset—its members. Major fire service agencies should align to promote a unified message and institute stricter policies or programs to prevent and manage CVD among its members. These programs include preplacement medical evaluations for recruits, annual medical evaluations for incumbents, return to work evaluations, and wellness programs.

Medical Evaluations

Medical evaluations are essential to preventing CVD among firefighters. The NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments describes the requirements of a comprehensive medical program for Fire Departments (24). The NFPA 1582 Standard is the definitive guide on medical evaluation programs in the US Fire Service and it is supported by major fire service organizations in the country. In fact, the International Association of Fire Chiefs has issued a position statement saying that every firefighter should receive a medical evaluation consistent with this Standard. Furthermore, the National Institute of Occupational Safety and Health routinely recommends that firefighter candidates and members receive medical evaluations consistent with NFPA 1582 and performed by physicians knowledgeable of the essential job tasks described in that document.

Pre-placement Medical Evaluations

Pre-placement medical evaluations should be included in the hiring process to assess baseline health status, identify candidates who require additional medical testing to determine eligibility, and exclude candidates who are unable to safely perform the essential job tasks. The medical assessment should also be used to generate a baseline CVD risk factor profile.

Annual Medical Evaluations

Annual medical evaluations are beneficial in terms of prevention, ongoing monitoring, and "teachable moments". Medical evaluations should provide an assessment of the CVD risk factor profile and would likely allow physicians to identify firefighters in need of risk reduction before an adverse event were to occur. Physicians could then provide counseling and aggressive treatment strategies to help firefighters reduce their risk of developing CVD. Evaluations

could also be used to identify firefighters who might need additional medical testing to determine whether they could safely perform their job. In some cases, a restriction from strenuous duty may be advisable based on fire department guidelines. In many cases though, return to full duty is possible. In a study conducted between 2000 and 2007, approximately 4500 medical evaluations were performed in accordance with the WFI. Based on these evaluations, there were 1936 referrals for follow-up of medical conditions and abnormalities. Subsequently, medical referrals led to the discovery of 80 critical findings. Nearly all firefighters (77) returned to full duty, 2 firefighters were placed on disability, and 1 firefighter retired. Presumably, consequences could have been much more devastating had the critical findings not been identified and managed.

Given the occupational hazards associated with CVD, it is important that medical evaluations be performed by a physician familiar with the essential job tasks of firefighting (see NFPA 1582) and that physicians advocate aggressive treatment of cardiovascular disease risk factors.

WFI Referrals for Follow-up of Medical Conditions, 2000–2007

- 1936 referrals (from ~4500 evaluations)
- 80 critical findings discovered from 2000–2007
- 77 firefighters returned to FULL DUTY
- 2 firefighters placed on disability
- 1 firefighter retired

Return to Work Evaluations

Return to work or fitness for duty evaluations are extremely important in the risk assessment and characterization of firefighters who have developed overt CVD. Studies have reported that nearly 30% of CHD-related fatalities occurred in firefighters with previously diagnosed CHD or a clinical equivalent, and a previous diagnosis of CHD is by far the strongest predictor of CHD-related line-of-duty death. Thus, based on current evidence, if firefighters with clinically significant cardiovascular disease were restricted from strenuous emergency duties, this measure could lead to a decrease of nearly 30% in CHD-related deaths. These facts underline the importance of a proper Return-to-Work evaluation for all firefighters after a CVD event or CVD diagnosis by a physician familiar with the cardiovascular strain of firefighting. The National Fire Protection Association has suggested criteria for determining the safe return to work in the presence of CHD that physicians and fire departments should follow.

NFPA 1582 Guidelines for Veteran Firefighters for Return to Work in the Presence of CHD (24)

- No angina
- No stenosis of major coronary artery (>70% of lumen)
- Normal left ventricular ejection fraction
- Exercise tolerance >12 METs during exercise stress test (EST)
- No exercise induced angina
- No ischemia or arrhythmias during EST (with imaging)
- No persistence of modifiable risk factor for plaque rupture (tobacco, high blood pressure, cholesterol >180, LDL >100, HbA1c >7)

Note: LDL, low-density lipoprotein; HbA1c, glycated hemoglobin.

Health and Wellness Programs

A comprehensive wellness programs should cover at least fitness, nutrition, injury prevention, and behavioral health. A well-recognized, effective wellness program developed specifically for firefighters is the Wellness Fitness Initiative (WFI), which was developed by the International Association of Fire Fighters and the International Association of Fire Chiefs. The WFI "seeks to demonstrate the value of investing wellness resources for the duration of uniformed personnel's careers in order to maintain fit, healthy, and capable fire fighters and EMS responders." In a recent study of 1000 male firefighters, researchers found that firefighters in departments with strong wellness programs (health promotion measures consistent with the WFI) were healthier than firefighters in departments with no wellness programs on many outcome measures that were important to firefighter health and operational readiness (26). Table 5 presents a comparison of several important outcome measures in firefighters with strong wellness programs compared with those without.

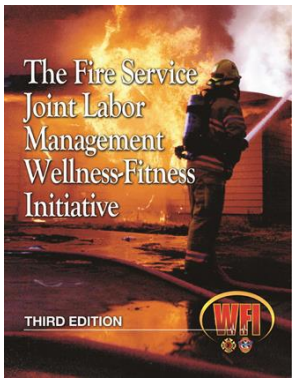

Table 5. Comparison of firefighters in departments with and without (Standard) a strong wellness program (26).

Health Outcome	Wellness Department	Standard Department
Obesity status (BMI-defined) (%)	25.3	35.6
Measured hypertension (%)	16.2	23.7
Meets NFPA recommended METs (% Yes)	46.8	43.0
Estimated VO_2max (mL/kg/min)	40.7 ± 0.6	37.5 ± 1.3
Exercises at station (% most-every day)	72.9	40.6

SUMMARY

Firefighting involves strenuous work in extreme environmental conditions, which results in considerable cardiovascular strain. Although most firefighters recover from the cardiovascular strain of firefighting without incident, there are too many that do not. Research findings conclusively show that strenuous firefighting activities can trigger sudden cardiac events in susceptible firefighters. Several studies have found that line-of-duty sudden cardiac events occur almost exclusively in firefighters who have traditional CVD risk factors and some type of underlying structural heart disease (8,18). Importantly, many risk factors for CVD are modifiable, and aggressive treatment can reduce the risk for SCD. Furthermore, nearly 30% of CHD-related fatalities occurred in firefighters with previously diagnosed CHD or a clinical equivalent. **Thus, careful return to work evaluations and restriction of duty for firefighters with clinically significant CVD could lead to a marked decrease in CHD-related deaths.**

Our understanding of CVD in the fire service has increased tremendously over the past 15 years. Although additional research is required to address remaining questions, that should not stall efforts to harness what we currently know and take aggressive steps to prevent and manage CVD to reduce cardiac-related deaths and disability in the fire service. To make significant progress, participation and buy-in at all levels is essential. Therefore, we have presented recommendations for reducing the risk of CVD that are targeted at different groups in the fire service.

RECOMMENDATIONS TO REDUCE CVD RISK IN THE FIRE SERVICE

"Because when we hit the fire ground, your risk factors become my risk factors."

–Firefighter Steve Mast, (Cedar Rapids) Iowa Fire Department)

Firefighters

Firefighters are ultimately the ones who must make the changes to reduce CVD in the fire service. Making these changes will require taking personal responsibility for one's health as well as adherence to policy and procedures. Firefighters must take an active role in reducing their risk for CVD. Based on current understanding of research, firefighters should:

1. Maintain a high level of physical fitness
2. Obtain an annual physical, even if it is not provided by your department
3. Routinely monitor blood pressure and control hypertension if present
4. Maintain or take actions to reach a healthy weight
5. Avoid tobacco use
6. Eat a healthy diet
7. Avoid excessive use of alcohol
8. Maintain normal lipid levels
9. Wear SCBA from initial attack to completion of overhaul
10. Get adequate sleep

Fire Department – Company Officer/Crew Boss

Company officers/crew bosses have a position of great influence and should act as intermediaries to reinforce existing policies and facilitate policy change when needed. Company officers/crew bosses should talk with their crews about specific actions firefighters can take to reduce their risk of CVD and should serve as a role model for firefighters. Based on current understanding of research, company offers/crew bosses should:

1. Encourage high levels of fitness
2. Promote good nutrition
3. Reinforce the importance of knowing your CVD risk factor profile and working to improve it
4. Promote a tobacco-free lifestyle
5. Encourage a supportive environment for meeting health and fitness goals
6. Ensure the wearing of SCBA from initial attack to completion of overhaul

Fire Service Leadership – National Organizations

National organizations play a key role in promoting health and wellness in the fire service. These organizations influence legislation and policy decisions and set the national priorities for the fire service. Based on current understanding of research,

it is recommended that fire service leaders take the following steps to prevent and manage CVD in the fire service:

1. Require pre-placement medical evaluations
2. Require annual medical evaluations
3. Require return to work evaluations
4. Implement physical fitness programs
5. Implement comprehensive wellness programs
6. Promote a tobacco free workplace
7. Ensure that incident scene rehabilitation is established for emergency incidents and training drills

Strategies to Encourage Adoption of Recommendations

The recommendations presented above are both practical and attainable, albeit not without challenges. To effect change, recommendations must be adopted, and there are always obstacles that must be overcome in the process. Given the recognized need to establish practices that best reflect the needs of the fire service, conference participants formed breakout groups that were tasked with focusing more narrowly on implementation and support of the recommendations. This included identifying the primary obstacles and most effective strategies to ensure that firefighters receive appropriate medical evaluations and have appropriate fitness levels. Participants had varied backgrounds and a broad range of expertise, which brought different perspectives to the discussions. To give a partial depiction of the participants and the organizations represented, responses from 23 of the participants who completed the post-conference survey are presented in Figure 8. There were 23 respondents, but based on the number of responses, there was some overlap of organizations represented. Respondents included a broad range of constituencies, including career firefighters (n = 16), volunteer (n = 1), allied professional (n= 2), and academic/research representative (n = 5). There was no shortage of experience at the meeting, with 70% of respondents indicating more than 20 years of related experience.

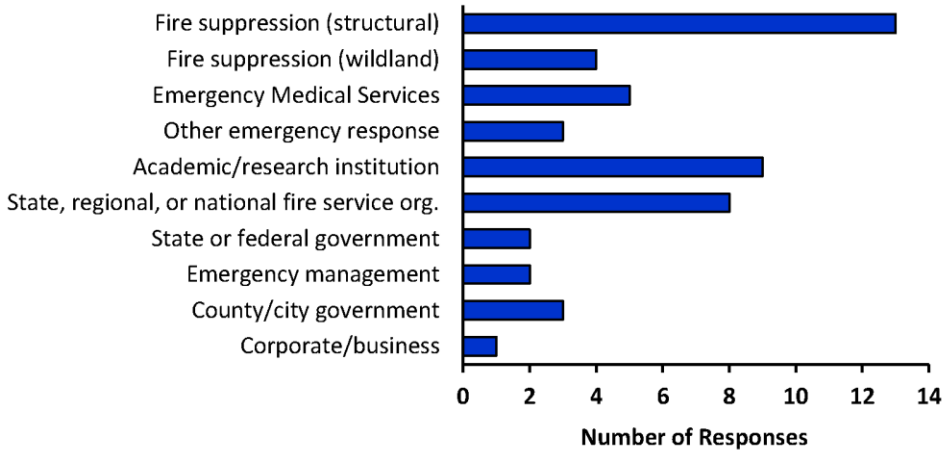

Figure 8. Responses to the post-conference survey question, "Which best describes the organization(s) you represented at Heart to Heart?"

Ideas on how to promote adoption of the recommendations related to medical evaluations that emanated from these breakout groups and from the post-conference survey are presented below. Responses to all questions posed to breakout groups are presented in Appendix B and responses to some of the post-conference survey questions related to future directions are presented in Appendix C.

Strategies to ensure that firefighters receive appropriate medical evaluations:

- *Mandated physicals.* Adopt NFPA 1582 medical standards for all firefighters regardless of organization type. This is a leadership responsibility.
- *Strategic plan for implementation of physicals.* Fire departments must work with multiple groups to adopt mandated physicals. Plans must include timeline and input from firefighters in the process.
- *Firefighters*. Members must take responsibility for their health, get a medical evaluation and work on reducing risk factors.
- *Designated, knowledgeable coordinator of health and wellness.* This individual will work to build trust and implement programming.
- *Success stories.* Ask survivors to advocate for prevention strategies. Identify firefighters who have dramatically improved their fitness/health and use them to send the message out to other firefighters (and their families) that positive changes are possible.
- *Strategic plan for implementation of physicals.* Include timeline and input from firefighters in the process.

Strategies to ensure that firefighters receive education/counseling about medical conditions following a medical evaluation. That is, what can be done to ensure that firefighters are not simply being cleared for duty (i.e., how can a medical

evaluation be kept from simply being a "cleared for duty" checklist that indicates everything is ok?)

- *Individual counseling after evaluation*.
- *Personal accountability*. Designate a member of the department to whom firefighters must report to ensure that firefighters are implementing the suggestions of the physician or doing the follow-up required.
- *Post-visit online education components.*
- *"Check up from the neck up" discussions.*
- *Group education.* (fellow firefighter with condition – what would you do?)

Importance of Lifestyle Choice to Reduce Risk of CVD (and Cancer)

- Exercise/Physical fitness
- Healthy diet/Nutrition
- Tobacco cessation
- Limited smoke exposure

Resources to help adopt/implement recommendations

1. IAFF/IAFC WFI Resource: *http://www.iaff.org/hs/wfiresource/default.html*
2. U.S. Fire Administration Health and Wellness Guide for the Volunteer Fire and Emergency Services: *www.usfa.fema.gov/downloads/pdf/publications/fa_321.pdf*
3. NVFC Heart-Healthy Firefighter Program: *http://www.healthy-firefighter.org*
4. NFFF 16 FLSI: *http://www.everyonegoeshome.com/16-initiatives*
5. American Heart Association web resources: *http://www.heart.org*
6. NFPA Standards: 1500, 1582, 1583, and 1584

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Appendix A – Meeting Participants

Conference Leadership:

Ronald J. Siarnicki, Executive Director, NFFF
Denise Smith, Ph.D., Skidmore College and the Illinois Fire Service Institute
Victor Stagnaro, Director of Fire Service Programs, NFFF
JoEllen L. Kelly, Ph.D., Director of Research, Everyone Goes Home® Program

Attendees

Michael Anderson, Captain, Pflugerville Fire Department; National Fallen Firefighters Foundation Everyone Goes Home® Program Western Advocate Manager

Dominique Ashen, Ph.D., C.R.N.P., Nurse Practitioner, Preventive Cardiology Johns Hopkins Ciccarone Center for the Prevention of Heart Disease

Angela Bennett, Faculty Member, Maryland Fire Rescue Institute NAFTD

Shawn Brimhall, Fire Protection Specialist, New York State Office of Fire Prevention

Jim Brinkley, Director, Department of Health and Safety IAFF

Jill Captain, M.D., Occupational Medicine Physician, Montgomery County (MD) Fire Rescue Service

Jennifer Chadwick, Executive Officer-Safety Division, San Antonio (TX) Fire Department

Michael Clauson, Battalion Chief, Sioux Falls (SD) Fire Rescue

Tony Coleman, Battalion Chief, Montgomery County (MD) Fire Rescue Service

Kevin Cooney, Fire Chief, South Windsor (CT) Fire Department; IAFC Volunteer and Combination Officers Section, NFFF Advisory Board Member

Susie Day, Ph.D., University of Texas School of Public Health

Walter Dix, President, Broward County (FL) Professional Fire Fighters IAFF Local 4321

Jeff Elliot, Tennessee State Fire Service Program Director NAFTD

Amy Espy-Smith, M.D., Director of Medical Operations Concentra

Kenneth Fent, Ph.D., Industrial Hygienist, CDC/NIOSH

Jorge Gardyn, M.D., Physician, Island Occupational Medical Resources, P.C.

Richard Gist, Ph.D., Assistant to the Fire Chief, Kansas City (MO) Fire Department

Daniel Gray, Deputy Chief-Safety and Personnel Services Division, Fairfax County (VA) Fire and Rescue Dept.

Raymond Gretz, Battalion Fire Chief, Washington D.C. Fire & EMS

Matthew Haerter, Battalion Chief, City of Kenosha (WI) Fire Department

Craig Haigh, Fire Chief, Hanover Park (IL) Fire Department

Bobby Halton, Firefighter; Editor in Chief, Fire Engineering

Craig Halver, Captain, Superstition (AZ) Fire and Medical District

Michael Hamrock, M.D., Physician, Boston (MA) Fire Department Last Call Foundation

Steven Hirsch, First Vice Chairman, National Volunteer Fire Council

Ken Holland, Senior Emergency Services Specialist, NFPA

Dan Kerrigan, Assistant Fire Marshal, East Whiteland Township (PA) Fire Dept.

Ellen Kessler, M.D., Medical Director, Inova Occupational Health

Melissa Knight, Program Manager, IAFC/FSTAR

Joseph Krebsbach, Deputy Chief, Indianapolis (IN) Fire Department

Todd LeDuc, Division Chief; Secretary, IAFC Safety, Health, and Survival Section

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Richard Miller, Program Manager, IAFC/FSTAR

Carolyn Muegge, Research Scientist, National Institute for Public Safety Health

Mike Novak, Battalion Chief, Branson (MO) Fire Department

Prabodh Panindre, Senior Research Scientist, New York University

Larry Petrick, Deputy Director Health and Safety, IAFF

Ernst Piercy, Fire Chief, retired, United States Air Force Academy

Nathan Queen, National Legislative Liaison, International Association of Black Professional Firefighters

Tim Radtke, Industrial Hygienist, U.S. Department of the Interior

Katie Rusk, Physician Assistant, San Diego Sports Medicine and Family Health; San Diego (CA) Fire-Rescue Department

Tim Sendelbach, Editor in Chief, Firehouse

Jim Sideras, Fire Chief, Sioux Falls (SD) Fire Rescue

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Colin Stowell, Assistant Fire Chief, San Diego (CA) Fire-Rescue Department

Susan Tamme, International Association of Women in Fire & Emergency Services

Tracy Thomas, Executive Officer Richmond (VA) Fire Department, IAFC-SHS

Matthew Tobia, Assistant Chief Loudon County (VA) Fire Rescue

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Maggie Wilson, Section Chief, FEMA

From the Survivor Community

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Steve Tullis, Firefighter/Paramedic, Hinsdale (IL) Fire Department/ NFFF Line-of-Duty-Death Survivor

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