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In this Issue

The Dr. Granito Award

Dr. John Granito Award for Excellence in Fire Leadership and Management Research

The Dr. Granito Award

Fire Protection Publications (FPP) and the *International Fire Service Journal of Leadership and Management (IFSJLM)* headquartered on the campus of Oklahoma State University (OSU) are proud to announce the creation of the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research (the Dr. Granito Award).** The award will be presented at the *IFSJLM* Research Symposium that supports the Journal held annually in July at the IFSTA Validation Conference. The award honors Dr. John Granito. John is one of the premier fire and public safety consultants in the United States. Just a few of his many Fire, Rescue, and Emergency services research projects include: Oklahoma State University-Fire Protection Publications Line of Duty Death Reduction project (3 years); Centaur National Study (3 years); Research Triangle Institute/National Fire Protection Association/International City/County Management Association project (4 years); Fire Department Analysis Project (FireDAP) of the Urban Fire Forum (13 years); *Combination Department Leadership* project, University of Maryland, Maryland Fire & Rescue Institute (4 years); Worcester Polytechnic/International Association of Fire Fighters/International Association of Fire Chiefs/ National Institute for Occupational Safety and Health *Fire Ground Performance Study* (current). He has participated in more than 400 fire department studies. John also has strong ties to academia. He has served in a number of academic positions for the past 27 years, and for the last 16 years has served at the State University of New York at Binghamton. He is Professor Emeritus and Retired Vice President for Public Service and External Affairs at SUNY Binghamton, which is consistently ranked in the top public universities by *U.S. News and World Report.* John has published numerous articles, chapters, and technical papers, served as co-editor of the 2002 book published by the International City/County Management Association entitled, *Managing Fire and Rescue Service*, and is a Section Editor of the NFPA® 2008 *Fire Protection Handbook.* Dr. Granito will be the first recipient of the award that honors him and his service to the fire service and to academia. Each year the recipient of the **Dr. Granito Award** will present the Keynote Address at the annual *IFSJLM* Research Symposium and will be the Guest of Honor at the reception held on Friday night prior to the Research Symposium.

Nomination Form

Fire Protection Publications (FPP) and the *International Fire Service Journal of Leadership and Management (IFSJLM)* headquartered on the campus of Oklahoma State University (OSU) are accepting nominations for the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research (the Dr. Granito Award).** The award is presented at the Research Symposium that supports the *International Fire Service Journal of Leadership and Management (IFSJLM)* held annually in July at the IFSTA Validation Conference.

The nominee should have made a significant contribution to the advancement of fire leadership and management through his/her scholarly/academic writing. The Dr. Granito Award is not necessarily a life-time achievement award, although such individuals certainly should be in a prominent position to be nominated. The nominee can be a person who, although early in their career as a practitioner/scholar or academic, has made a seminal contribution to the fire leadership and management literature.

To nominate an individual for the Dr. Granito Award, please submit by 15 January of the symposium year: (1) this form (or a copy of it), (2) no more than a one-page single-spaced letter explaining why you believe the person is deserving of the award, and (3) a copy of the nominee's resume or curriculum vitae. Send the materials to: Dr. Granito Award, Dr. Bob England, Editor, *International Fire Service Journal of Leadership and Management,* Department of Political Science, 531 Math Sciences, Oklahoma State University, Stillwater, Oklahoma 74078.

I nominate ____ for the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research.** To support the nomination, I have included a letter of recommendation and a resume or curriculum vitae (CV) of the nominee. (A nomination is not accepted without the supporting letter and resume/CV.)

Nominator Name: ____

Address: ____

____

Zip/Postcode: ____

Contact Information:

Telephone: ____

Email: ____

Dr. Lori Moore-Merrell, International Association of Firefighters
Dr. Ainong Zhou, Statistical Consultant
Sue McDonald, International Association of Firefighters
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Contributing Factors to Firefighter Line-of-Duty Deaths in the United States

Abstract

The objective of this study was to analyze retrospective data from the years 2000-2005 (six years) to identify and quantify the major factors that contribute to firefighter line-of-duty deaths (LODD) in the United States. The identified contributing factors were examined for frequency of occurrence and clustering with other factors. A total of 644 cases were included in the study. Frequency analysis revealed that the dominant contributing factors to LODD are health/fitness/wellness (53.88%), personal protective equipment (19.41%) and human error (19.1%). Cluster analysis was performed revealing contributing factors frequently occurring together. Four main clusters were identified with these contributing factors. Cluster 1 included incident command, training, communications, standard operating procedures, and pre-incident planning. Cluster 2 included vehicles, personal protective equipment, equipment failure, and human error. Cluster 3 included privately owned vehicles, accidental, and civilian error. Cluster 4 included company staffing, operating guidelines and health/fitness/wellness. Cluster 4 alone (regardless of other clusters) was shown to be responsible for more than 44.72 percent of all firefighter on-duty deaths during the years studied. Cluster 4 in conjunction with other clusters was shown to be responsible for an additional 16 percent of all firefighter line-of-duty deaths during the years studied. Data show that 97.5 percent of all firefighter LODD occurring between the years of 2000-2005 are attributable to an identifiable cluster of contributing factors. Approximately half of all firefighter LODD that occurred between these years are attributable to a cluster of three factors that are under the direct control of the individual firefighter and chief officers. The information revealed in this study imposes a considerable burden on decision makers and fire service leaders as well as firefighters themselves. It offers substantial guidance for shaping local fire department policy decisions and operational priorities.

Introduction

Year after year, there are notable advancements in the fire service industry. These advancements range from building code improvement to sprinkled buildings, from better protective gear to technologically advanced apparatus. Many profound advances have also been made in both laws and programs designed to improve worker safety and health for all workers in the United States. For example, since the 1970s, the Federal Emergency Management Agency (FEMA), United States Fire Administration (USFA), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH) have initiated and published numerous projects to improve the ability of employers and employees to recognize, avoid and control occupational safety and health hazards. Special projects and training programs were conducted for small and medium-sized businesses, high-hazard industries, leaders of organized labor, supervisors, apprentices, and others. Generally, these improvements were made with the best interests of the worker in mind. However, the reduction of deaths or reduced frequency and severity of injuries and illnesses is unevenly distributed. While some industries and particular trades have enjoyed a reduction in injuries, diseases, and death, many other occupations have experienced little or no change at all. For example, the fire fighting profession illustrates the selective impact of past safety and health initiatives. Despite the advances made in safety and health areas, firefighters are still being killed, injured and diseased at an alarming rate.

The provision of fire suppression and emergency medical services entails sporadic high levels of physical exertion, uncontrolled environmental exposures, and psychological stress from observing intense human suffering. Firefighters experience inordinate numbers of line-of-duty deaths, deaths due to occupational diseases, forced retirements, and line-of-duty injuries. Firefighter fatalities and injuries occur at a rate one and one half times those of police officers (FBI, 2004; NFPA®, 2004).

There are approximately 296,850 career firefighters and 800,050 volunteer firefighters in the United States (NFPA®, 2005). In spite of the improvements mentioned, scores of firefighters are injured and approximately 100 firefighters are killed in the line of duty each year (FEMA, 2005). One anticipated outcome of this study is to enhance risk management capability of local governments by enabling fire departments to recognize factors that contribute to firefighter line-of-duty deaths and take action to interrupt or otherwise control these factors, thereby managing the risk associated with a LODD resulting in an enhancement to firefighter safety.

A similar effort currently underway is the "Near Miss Project" supported by the International Association of Fire Chiefs (IAFC), the Volunteer and Combination Officers' Section of the IAFC and the International Association of Firefighters (IAFF). The intent of this project is to improve firefighter safety through sharing *lessons learned* about incidents of injury-producing behavior. "Near Miss" data are being compiled for analysis to assess firefighter injury-producing behavior in order to alter the behavior and lower the risks of an incident. Once data are compiled and the analysis complete, results can be used to improve command, on-scene operations, and firefighter training thus reducing injury and LODD (Firefighter Near Miss, 2008). This system is based on lessons learned from the aviation industry where near miss reporting significantly improved the safety record of the nation's air travel. "Near Miss" reporting anticipates the same result as those discovered in the aviation industry whereas the earlier the risk or error chain leading to a disaster is interrupted, the more likely the catastrophe can be avoided. Likewise, the intent of this study is to better identify the chain or cluster of events leading to a firefighter LODD allowing recommendations for risk management strategies to interrupt the chain. The results of this study will be helpful in honing and categorizing the contributing factors used in the "Near Miss Project."

Methods

Study Design

Subjects selected for inclusion in the study were those identified and recorded as firefighter LODD for the years of 2000 through 2005. The data were compiled from six years of verified firefighter LODD from four reputable industry sources. Sources include the National Fire Protection Association (NFPA®), the National Institute for Occupational Safety and Health (NIOSH), the United States Fire Administration (USFA) and the International Association of Firefighters (IAFF). Data compiled included cases of line-of-duty deaths as well as known contributing factors, date of incident, date of death, firefighter age, sex, city, state, zip code, population density, type of department, department staffing, response time to the incident, type of occupancy, type of building, type of injury leading to death, and injuries of firefighters related to the death. Data for each LODD and associated contributing factors were compiled from reports profiling the incident leading to death as communicated by witnesses on scene and recorded by one of the four organizations listed above. In addition to the witness accounts, NIOSH post-incident investigation reports were also used to record contributing factors to LODD for cases resulting in an investigation. A total of 644 cases had sufficient information available for inclusion in the study.

Data Synthesis

This study was based on data extracted from the U.S. Fire Administration (USFA) On-Duty Fatality Notices for years 2000, 2001, 2002, 2003, 2004 and 2005 (see, for example, USFA 2008) and from in-depth firefighter fatality investigation reports for the same years by the National Institute for Occupational Safety and Health (NIOSH). These data were cross-referenced with LODD recorded by both the NFPA® and the IAFF. Firefighter deaths associated with the tragedy at the World Trade Center in 2001 were excluded from the study.

USFA criteria for qualifying as a line-of-duty fatality (also known as on-duty fatality) were followed for this study. According to USFA, on-duty fatalities include any injury or illness sustained while on-duty that proves fatal. The term on-duty refers to being involved in operations at the scene of an emergency, whether it is a fire or non-fire incident, responding to or returning from an incident, performing other officially assigned duties such as training, maintenance, public education, inspection, investigations, court testimony, and fundraising, and being on-call, under orders, or on standby duty, except at the individual's home or place of business.

A fatality may be caused directly by an accidental or intentional injury in either emergency or non-emergency circumstances, or it may be attributed to an occupationally related fatal illness. A common example of a fatal illness incurred on-duty is a heart attack. Fatalities attributed to occupational illnesses also would include a communicable disease contracted while on-duty that proved fatal, when the disease could be attributed to a documented occupational exposure.

Injuries and illnesses are included when the death is considerably delayed after the original incident. When the incident and the death occur in different years, the analysis counts the fatality as having occurred in the year in which the incident took place.

An individual who experiences a heart attack or other fatal injury at home as he or she prepares to respond to an emergency is considered on-duty. A firefighter who becomes ill while performing fire department duties and suffers a heart attack shortly after arriving home or at another location may be considered on-duty because the inception of the heart attack occurred while the firefighter was on-duty. Prior to December 15, 2003, a firefighter who became ill as the result of a heart attack or stroke after going off duty needed to register some complaint of not feeling well while still on-duty in order to be included in the USFA study. On December 15, 2003, the President of the United States signed into law the Hometown Heroes Survivors Benefit Act of 2003. The law presumes that a heart attack or a stroke is in the line of duty if the firefighter was engaged in non-routine stressful or strenuous physical activity while on-duty or within 24 hours after engaging in such activity.[1]

It is the position of the USFA that there is no established mechanism for identifying fatalities resulting from illnesses, such as cancer that develops over long periods of time, which may be related to occupational exposure to hazardous materials or products of combustion. Though the IAFF tracks and strenuously supports that firefighter deaths due to cancer or other diseases resulting from long-term or otherwise fatal on-the-job exposures are LODD, these were excluded from this study. This exclusion is based on the delayed long-term effects of such toxic hazard exposures.

Study Protocol

Data were compiled from eyewitness reports and post-incident investigation reports from four nationally recognized sources for firefighter LODD information. Identified cases of LODD were evaluated for sufficient information for inclusion in the study. Next, each case was individually cross-referenced with all data sources to assure all available information was collected on each case and to assure no cases were counted twice. Data tables were prepared with all study-relevant information.

Data were then analyzed to identify and define contributing factors of firefighter LODD. As contributing factors were identified, a variable key was constructed containing each variable name and the definition as referenced in data source reports. Frequency analysis as well as cluster analysis were performed on all cases. Cluster analysis was used to organize the data into meaningful structures, or develop taxonomies. The aim of cluster analysis was to sort different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. This method is typically used to discover structures in data without providing an explanation/interpretation of why they exist.

Data Analysis

Initial analysis identified the overall dominant contributing factors as well as the dominant factors in each of five strata. Strata included firefighter age, department type, scene type, population density, and census region. Next, data were analyzed for clustering between contributing factors and the frequency of that cluster. Four oblique clusters of the contributing factors were identified using the VARCLUS Procedure available with SAS software (Version 9.1, SAS Institute). Those contributing factors with no more than 5 percent mentioned were excluded from the cluster analysis. A binary score was calculated for each cluster based on presence/absence of any of its constituent contributing factors. Finally, these contributing factor clusters were evaluated for the significance of their contribution to firefighter LODD in the six years studied. The relative contribution of these clusters was also evaluated within each stratum identified previously. All data analyses were conducted using the SAS software.

Results

There were 644 cases identified with sufficient information for inclusion in the study. Firefighter LODD characteristics are shown in Table 1. Age information was not available for four of the cases and department type was not identified in one case. Additionally, the state of occurrence was not identified in three cases. Stratified analyses were limited to cases with sufficient strata specific data.

As is expected, based on the make-up of the fire service, the majority of LODD cases are male (96%). For the years and cases included in the study, more firefighter LODD occur in volunteer departments (52%) as compared to career (39%) or combination (9%) and the majority of firefighters dying are over the age of 45 (52%). Regionally, more firefighter LODD occurs in the south (34%) than in any other census region.

Table 1. Characteristics of Firefighter LODD Cases Included in the Study (N=644)

Age	
Less than 25	68
25-35	89
36-45	147
46-55	191
Greater than 55	145
Unidentified	4
Gender	
Male	620 (96%)
Female	24 (4%)
Department Type	
Career	252
Volunteer	333
Combination	58
Other	1
Census Region	
Northeast	169
Midwest	127
South	218
West	127
Other	3

Contributing Factors were identified. Each factor was identified from case studies or eyewitness reports, defined from literature or descriptions contained in LODD reports and assigned a variable name for the study. The contributing factor, definition and variable name are listed below.

- **Incident Commander (IC)** – Individual responsible for the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident or training exercise (NFPA® Standard 1670, 424).
- **Incident Safety Officer (ISO)** – An individual appointed to respond to or assigned at an incident scene by the incident commander to perform the duties and responsibilities specified in NFPA® standard 1521 and 1584. This individual can be the health and safety officer or it can be a separate function (NFPA® Standard 1581, 1524).
- **Personal Alert Safety System (PASS)** – Device certified as compliant with NFPA® standard 1982, that senses movement and/or lack of movement and automatically activates an audible alarm signal (which can also be manually activated) to alert and assist others in locating a firefighter or emergency provider in danger (NFPA® Standard 1982).
- **Staffing/Crew Size (STAFF)** – (Fire Crew or Company) A group of members: (1) Under the direct supervision of an officer; (2) Trained and equipped to perform assigned tasks; (3) Usually organized and identified as engine companies, ladder companies, rescue companies, squad companies, or multi-functional companies; (4) Operating with one piece of fire apparatus (engine, ladder truck, elevating platform, quint, rescue, squad, ambulance) except where multiple apparatus are assigned that are dispatched and arrive together, continuously operate together, and are managed by a single company officer; (5) Arriving at the incident scene on fire apparatus (NFPA® Standard 1710).[2] An organized group of firefighters under the leadership of a crew leader or other designated official (NIFC, 2006).
- **Rapid Intervention Team (RIT)** – Two or more firefighters assigned outside the hazard area to assist or rescue at an emergency operation as required by 6-4.4 of NFPA® 1500, Standard on Fire Department Occupational Safety and Health Program (NFPA® Standard 1410).
- **Training (TRAIN)** – The process of achieving proficiency through instruction and hands-on practice in the operation of equipment and systems that are expected to be used in the performance of assigned duties (NFPA® Standard 600-601).
- **Communications (COMM)** – Radio, telephone, and messenger service networks throughout the emergency response system necessary to facilitate direct communication from the incident commander to officers, firefighters and emergency providers in tactical operations (NFPA® Standard 130, 502, 1221).
- **Standard Operating Guidelines (SOG)** – An organizational directive that establishes a common practice or course of action during tactical operations. Guidelines are intended to allow an incident commander and firefighters/emergency responders to adapt to variations in incident types within the same category (e.g. single-family residential structure fire vs. high-rise structure fire) while providing overall consistency in tasks to be conducted on every incident.
- **Standard Operating Procedures (SOP)** – A written organizational directive that establishes or prescribes specific operational or administrative methods to be followed routinely for the performance of designated operations, actions or administrative functions (NFPA® Standard 1521).
- **Privately Owned Vehicle (POV)** – A motor vehicle owned and operated by an individual firefighter, used in the response to a call for service.
- **Pre-Incident Plan (PIP)** – A document developed by gathering general and detailed data at a specific facility to be used by responding personnel to determine the resources and actions necessary to mitigate anticipated emergencies (NFPA® Standard 1620).
- **Emergency Vehicle (VEH)** – Any vehicle operated by a fire department member including those used for rescue, fire suppression, emergency medical services, hazardous materials operations, wildland, or other functions (NFPA® Standard 1581).
- **Personal Protective Equipment (PPE)** – The equipment provided to shield or isolate personnel from infectious, chemical, physical, and thermal hazards (NFPA® Standard 1670).
- **Health/Fitness/Wellness/Medical (HFWM)** – The state of uniform personnel signifying a deficiency or absence of physical, mental, or emotional capability to withstand the stresses or strains of living and functioning in the workplace. This adverse state results from cumulative factors including job exposures, stress and personal behavior including poor diet and general lack of exercise.
- **Structural Failure (SF)** – Structural collapse brought on by fire that precludes buildings or

structural components from functioning as designed.

- **Emergency Equipment Failure (EEFAIL)** – The unacceptable difference between expected and observed performance of emergency equipment.
- **Act of Violence (VIOL)** – Exertion of physical force to injure, abuse or cause death.
- **Act of Nature (NAT)** – An extraordinary and unexpected natural event, such as a hurricane, tornado, earthquake or even the sudden death of a person.
- **Accidental (ACC)** – Arising from extrinsic causes occurring unexpectedly or by chance happening without intent or through carelessness and often with unfortunate results.
- **Human Error (HE)** – A mistake made by a person rather than caused by a poorly designed process or the malfunctioning of equipment.
- **Dangerous Substance (DS)** – Synonymous with the term hazardous materials defined as a combustible liquid, corrosive material, infectious substances, flammable compressed gases, oxidizing materials, poisonous articles, radioactive materials, and other restrictive articles (NFPA® Standard 402). Also includes articles or substances capable of posing a significant risk to health, safety, or property when transported by land, air, rail or sea (NFPA® Standard 1003).
- **Civilian Error (CE)** – Persons who are members of the general public and who are not fire service or other emergency services personnel (NFPA® Standard 180) who in an act or condition of ignorant or imprudent behavior unintentionally cause an adverse event.

Following contributing factor identification and definition, raw frequency scores and percent *mentioned* were determined for each factor. Dominant contributing factors were identified by percentage for the overall data set and in various categories as described in Table 2 below.

Table 2. Dominant Contributing Factors by Strata (Top 3 Percentages Shown)

Strata	Contributing Factor (% LODD)
Overall	HWFM (53.8) PPE (19.4) HE (19.1)
Age	
Less than 25	HE (60.87) VEH (40.6) PPE (34.8)
25-35	SOP (33.7) VEH (31.5) PPE (30.3)
36-45	HWFM (51) SOP (21.1) IC (18.4) PPE (18.4)
46-55	HWFM (66.6) SOG (20.7) PPE (16.1)
Greater than 55	HWFM (75.8) SOG (11.1) PPE (11.1)
Department Type	
Career	HWFM (42.8) EEFAIL (26.2) PPE (21.1)
Volunteer	HWFM (61.4) HE (20.1) VEH (15.9) PPE (15.9)
Combination	SOG (62.1) HWFM (58.6) PPE (32.8)
Census Region	
Northeast	HWFM (66.3) SOG (15.4) HE (13.6)
Midwest	HWFM (55.1) PPE (28.4) SOP (23.6)
South	HWFM (54.1) PPE (21.1) HE (20.1)
West	HWFM (35.4) EEFAIL (31.5) HE (26.7)
Population Density	
Less than 500/sq mile	HWFM (47.6) PPE (32.4) SOG (30.3)
501 – 1500/sq mile	HWFM(56.5) SOG(17.0) EEFAIL(15.6) VEH(15.6)
1501 – 3000/sq mile	HWFM (54.8) PPE (23.1) HE (20.2)
Greater than 3000/sq mile	HWFM (57.7) SOP (23.1) PPE (21.5)
Scene Type	
Structure Fire	HWFW (48.7) IC (43.9) SOP (38.6)
Responding/Returning	HE (53.5) VEH (47.2) CE (43. 3)
Station/Home	HWFM (89.6) SOG (28.8) PPE (11.2)
Training	HWFM (63.2) EEFAIL (23.5) SOG (23.5)
Wildland	EEFAIL (44.4) HFWM (35.2) IC (14.8) SOP (14.8)

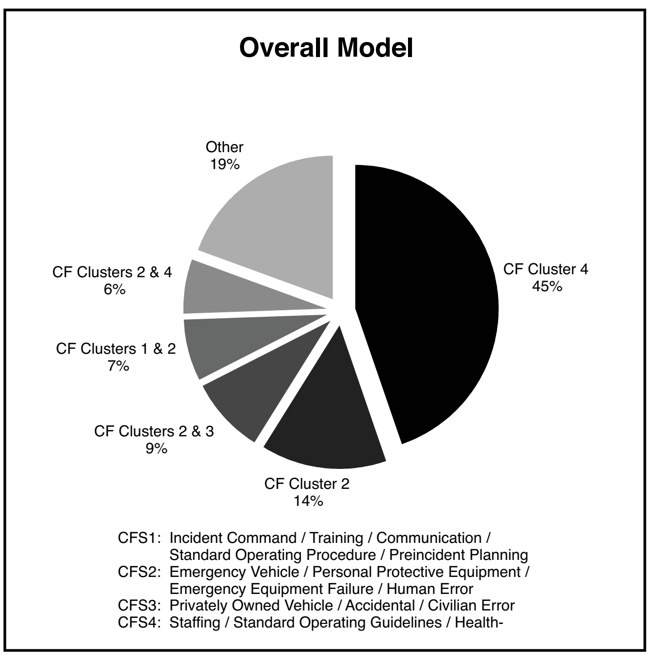
According to cluster analysis, four clusters of contributing factors were identified. Those contributing factors with no more than 5% mentioned were excluded from the cluster analysis. Composite cluster variables are listed in Table 3 below.

Table 3. Composite Cluster Variables

Contributing Factor Clusters	
Cluster 1	Incident Command, Training, Communications, SOP, Pre-incident Planning
Cluster 2	Emergency Vehicle, Personal Protective Equipment, Emergency Equipment Failure, Human Error
Cluster 3	Privately Owned Vehicle, Accidental, Civilian Error
Cluster 4	Staffing/Crew Size, Standard Operating Guidelines, Health/Wellness/Fitness/ Medical

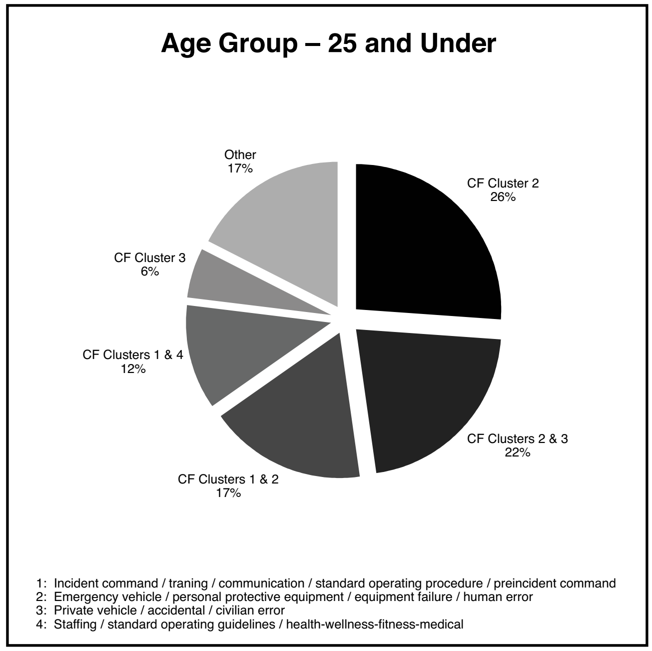
The four clusters identified by the analysis are responsible for 97.52 percent of all LODD in the years studied. The remaining LODD (2.48%) were not explained by any contributing factor cluster. Among the composite clusters, Cluster 4 alone, excluding its interaction with any other contributing factors, is responsible for 44.72 percent of LODD. Cluster 2 alone is responsible for another 14.13 percent. A combination of Cluster 2 and Cluster 3 are responsible for an additional 8.70 percent of LODD. The remaining 32.45 perent of LODD are explained by another cluster alone or in combination as described in Figure 1 below.

Figure 1. Overall Model of Composite Clusters for LODD



The relative contribution of these clusters within each stratum was evaluated as an attempt to hone contributing factor clusters to specific environments making risk management efforts more direct and efficient. Strata evaluated included firefighter age, type of department, census region, population density and scene type.

Figure 2. Age Group 25 and Under



Firefighter age strata were defined as 25 and under, 26-35, 36-45, 46-55, and over 55. Cluster 2, comprised of emergency vehicle, personal protective equipment, emergency equipment failure, and human error, was responsible for more than 26 percent of LODD in firefighters 25 and under while a combination of Clusters 2 and 3 was responsible for an additional 22 percent. Cluster 4 was responsible for the majority of deaths in all other age groups with the percentage of attributable deaths increasing with age. For firefighters over 55, Cluster 4 was responsible for nearly 70 percent of LODD. Figures 2 – 6 show contributing factor clusters by firefighter age group.

The next strata evaluated were department type. These strata were defined as career, volunteer and combination. Figures 7-9 show the contributing factor clusters most responsible for LODD in these strata. While Clusters 4 and 2 were responsible for half of LODD in Career Departments, Cluster 4 alone was responsible for more than 56 percent of LODD in Volunteer Departments. Cluster 4 alone was responsible for nearly 40 percent of LODD in Combination Departments while Cluster 4 in combination with Cluster 2 was responsible for an additional 15.5 percent.

Data were also stratified by census region to highlight area differences in contributing factor clusters. These differences are significant; however, reasons for the differences can only be assumed based on knowledge gained from fire industry experience. For example, the regional differences in the dominate cluster between the Northeast (Cluster 4 = 59.8%) and the West (Cluster 2 = 31.5%) may be attributed to firefighter and officer training differences or to the implementation of well-

Figure 3. Age Group 26-35

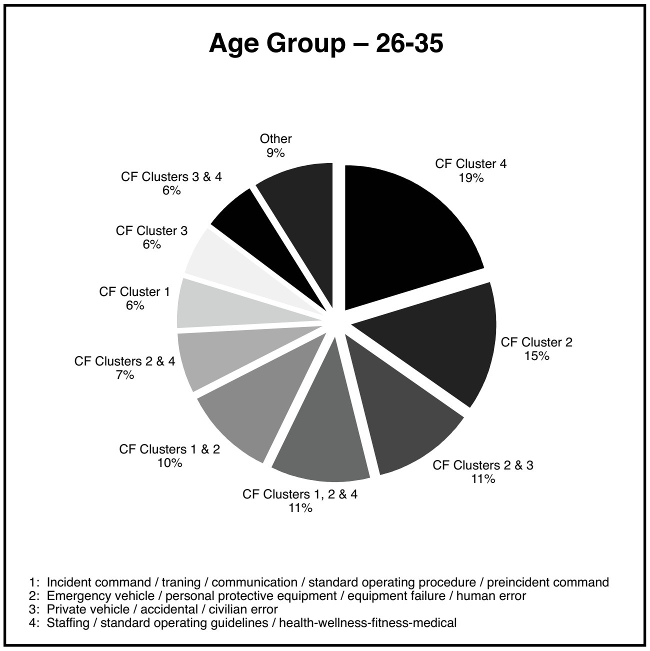


Figure 5. Age Group 46-55

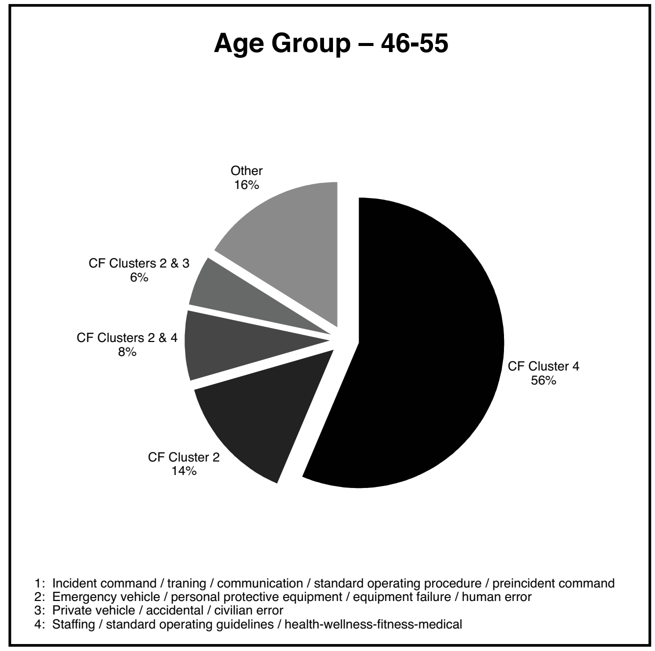


Figure 4. Age Group 36-45

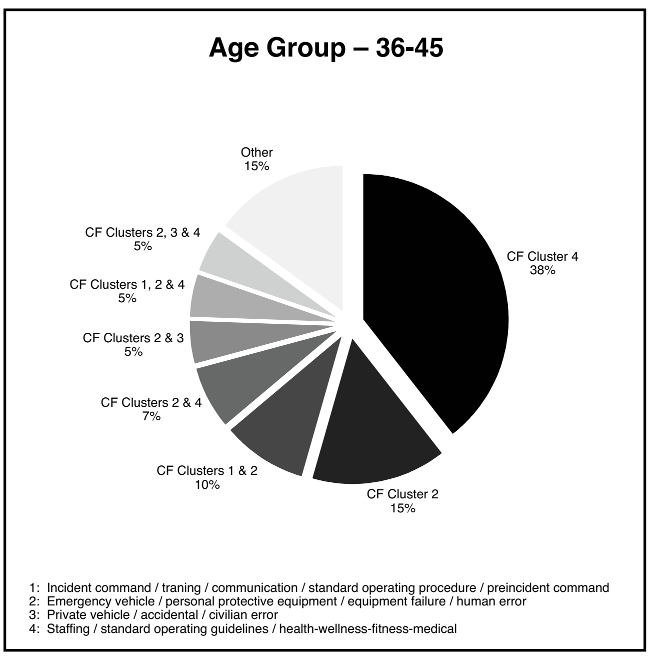
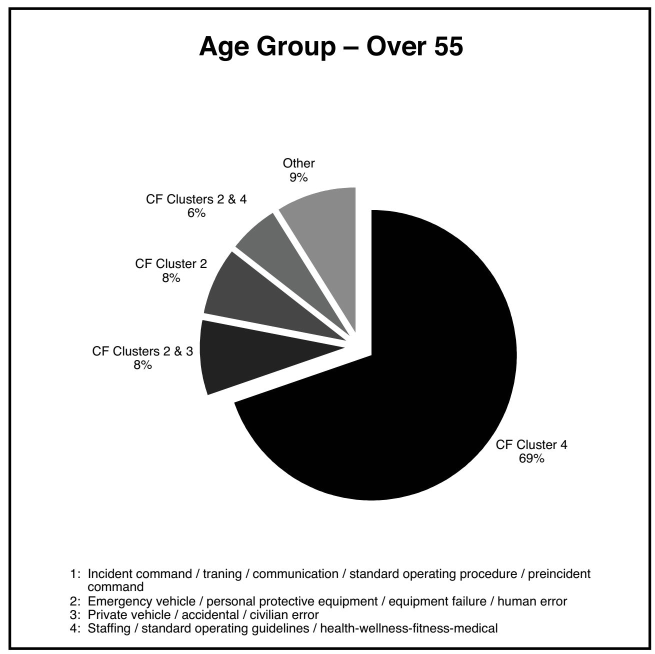


Figure 6. Age Group Over 55



ness/fitness initiatives (or lack thereof) in these regions. Census region strata were defined as West, Northeast, Midwest, and South. Figures 10-13 show the contributing factor clusters most responsible for LODD in these strata.

Data were also stratified by the population density in the jurisdiction of occurrence. Population density was used as a proxy for department size. Analysis of these strata was used to highlight differences in contributing factor clusters according to department size. Results show that there are no significant differences in the clusters of contributing factors in the strata defined. In each stratum (less than 500/square mile, 501 – 1000/square mile, 1001 – 3000/square mile and greater than 3000/square mile) Cluster 4 was most responsible for LODD followed by Cluster 2 and then a combination of Clusters 1 and 2.

Finally, data were stratified by scene type. The various scene types identified include structural fire, responding/returning, station/home, training, wildland and other on-duty events. As noted in Figures 14 – 19 below, there were differences in the contributing factor clusters responsible for LODD between these strata. Analysis of contributing factor clusters for LODD occurring at structure fires shows that Cluster 4 is responsible for 35.5 percent of deaths while a combination of Clusters 1 and 2 are responsible for another 10.1 percent. In the stratum for responding/returning, Cluster

Figure 7. Career Departments

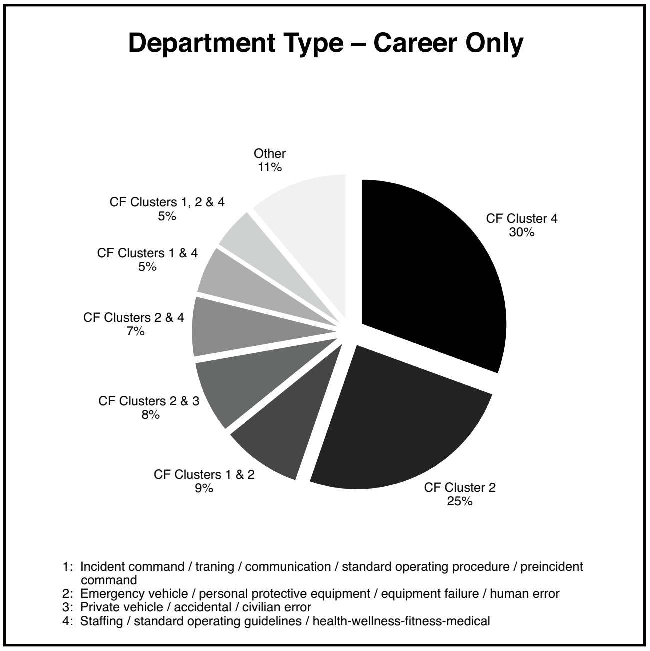
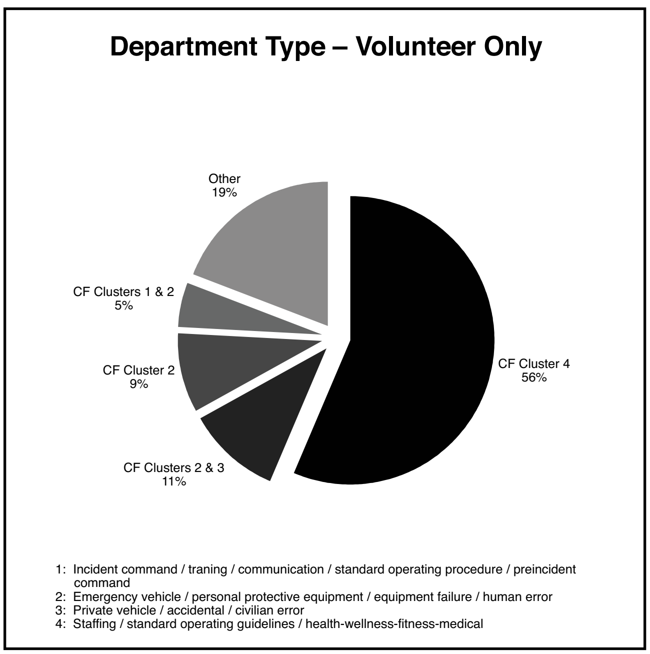
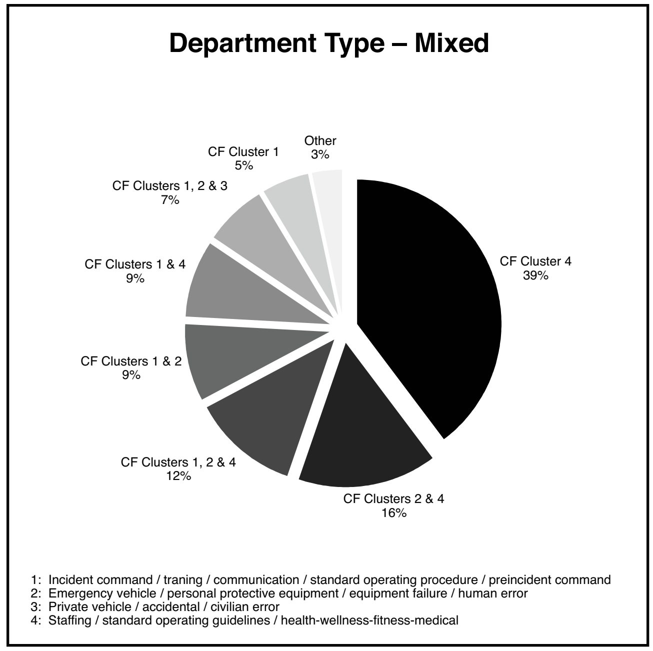


Figure 8. Volunteer Departments



4 once again is dominante and responsible for 33 percent while a combination of Clusters 2 and 3 is responsible for another 20.7 percent. As expected, Cluster 4 is overwhelmingly responsible for LODD (76%) in the station/home stratum. This stratum shows the majority of LODD due to heart attack or stroke deaths occurring in the station or at home just before or after a duty shift. This particular stratum, in conjunction with the dominance of Cluster 4 overall, represents justification for the “Hometown Heroes Survivors Benefit Act” and the new Department of Justice rules for Public Safety Officer Benefits (PSOB) program. The next “scene type” evaluated is training. The training stratum again shows Cluster 4 as dominant (45.7%) while Cluster 2, includ-

Figure 9. Combination Departments



ing personal protective equipment and human error, is responsible for an additional 20 percent of deaths in this arena. The final stratum specifically evaluated was wildland. In this stratum, Clusters 4 and 2 were tied in the amount of deaths for which they are responsible (33.3% each). The ‘Other On-duty’ stratum represents cases including EMS calls, water rescue, high-rise rescue, other types of rescue and storm watch.

Discussion

According to the USFA, the term firefighter covers all members of organized fire departments in all States, the District of Columbia, the Territories of Puerto Rico, the Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam. It includes career and volunteer firefighters, full-time public safety officers acting as firefighters, 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. The term firefighter also includes contract personnel working as firefighters or assigned to work in direct support of fire service organizations. It includes not only local and municipal firefighters but also seasonal and full-time employees of the United States Forest Service, the Bureau of Land Management, the Bureau of Indian Affairs, the Bureau of Fish and Wildlife, the National Park Service, and State wildland agencies. The definition also includes prison inmates serving in firefighting crews; firefighters employed by other governmental agencies, such as the United States Department of Energy; military personnel performing assigned fire suppression activities; and civilian firefighters working at military installations (FEMA, 2005).

Figure 10. West Region

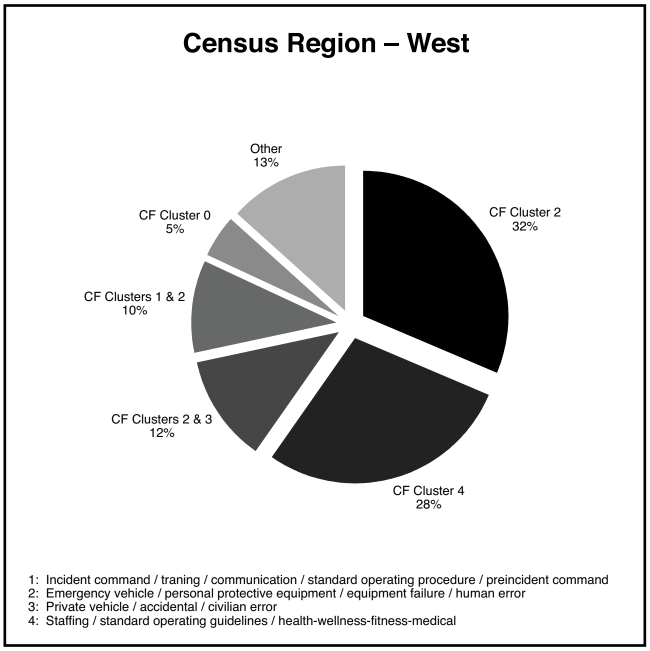


Figure 11. Northeast Region

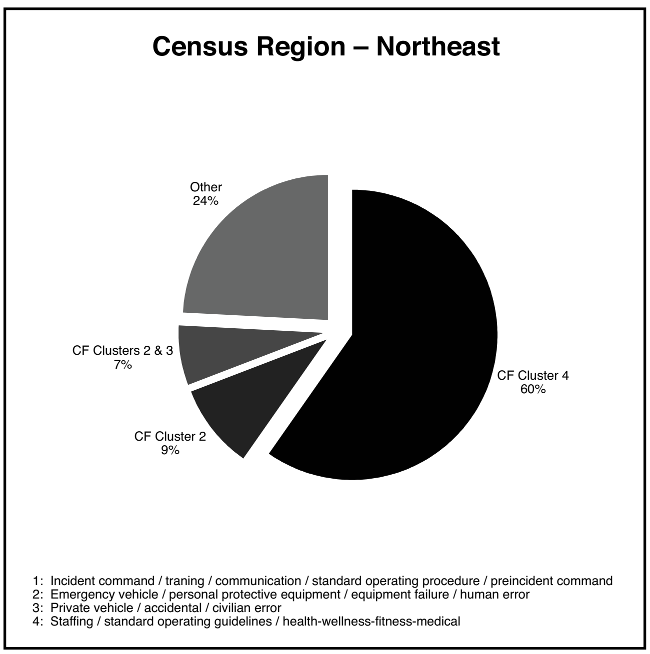


Figure 12. Midwest Region

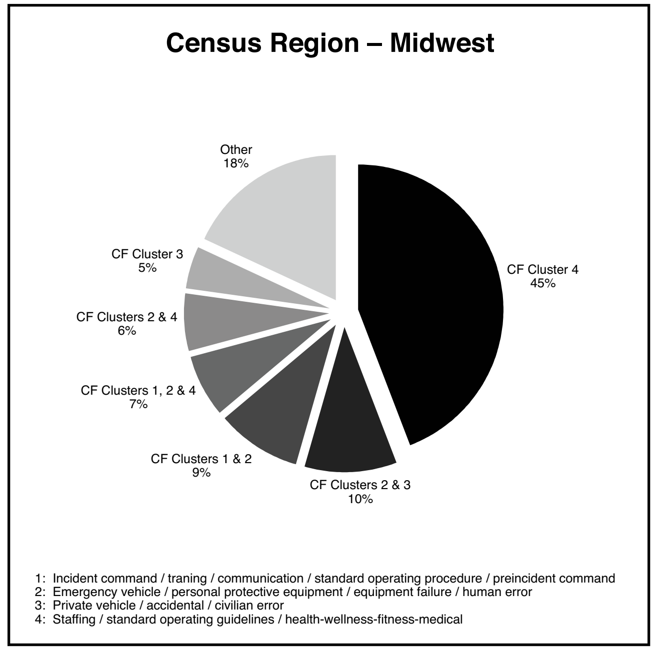
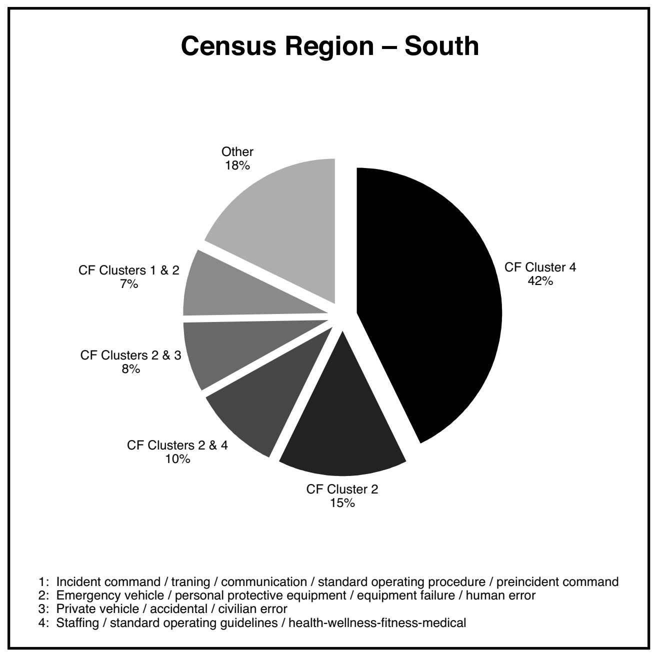


Figure 13. South Region



Geographical Information System (GIS) analysis was used to produce map exhibits depicting firefighter deaths. These maps are complex and multi-colored and cannot be included here.[3] Among other findings, however, they show for the years studied, excluding the 9/11 deaths, Pennsylvania experienced more deaths than any other state (58), followed closely by New York (49) and Texas (43). The maps also show (1) the dominant contributing factor clusters responsible for firefighter deaths regionally in the United States for the years 2000-2005 (data previously provided in Figures 10-13); (2) firefighter LODD by census region and age of firefighter (also see Table 1); and (3) LODD by fire department type and census region (also see Table 1).

The environments in which firefighters live and work include the station, training exercises, fire or emergency medical scenes, responding or returning from scenes and a host of others. These environments are multi-factorial in nature; therefore, a key challenge to the study was identifying the contributing factors and then sorting out the relative contributions of the various factors identified. This identification was completed with the results recorded.

During the analysis, it was noted that factors may act independently of each other or they may act synergistically with the interaction of factors presenting a greater total risk than the sum of their individual effects. Unfortunately, these effects could not be assessed in this

Figure 14. Structure Fire

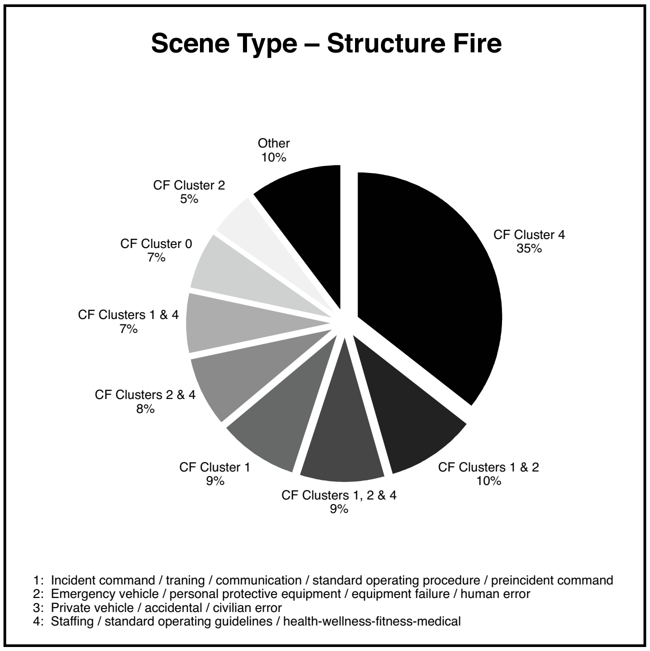


Figure 15. Responding/Returning from Incident

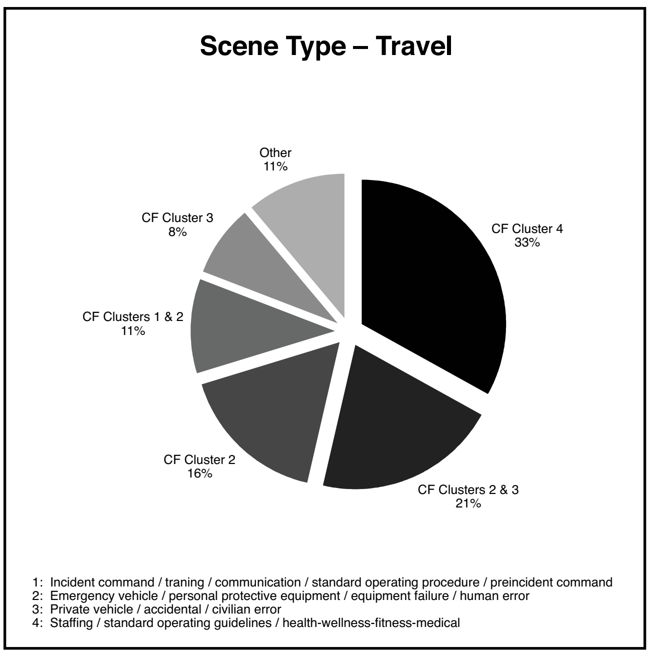


Figure 16. Station/Home

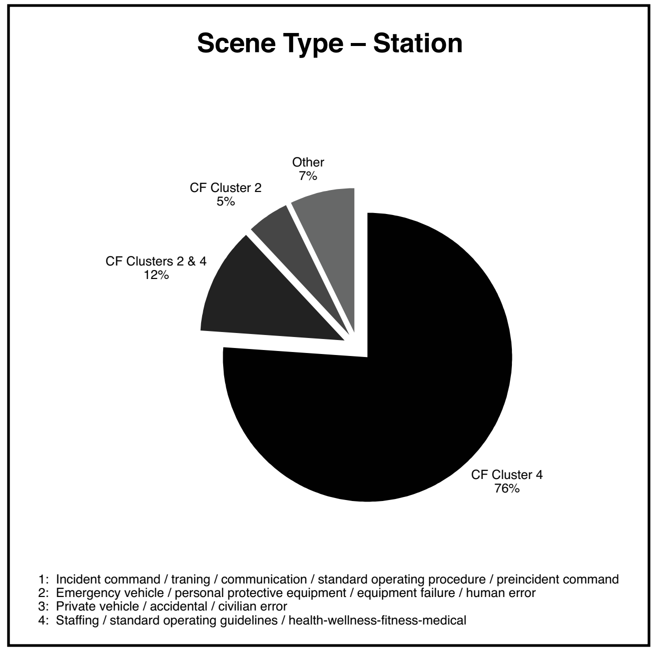
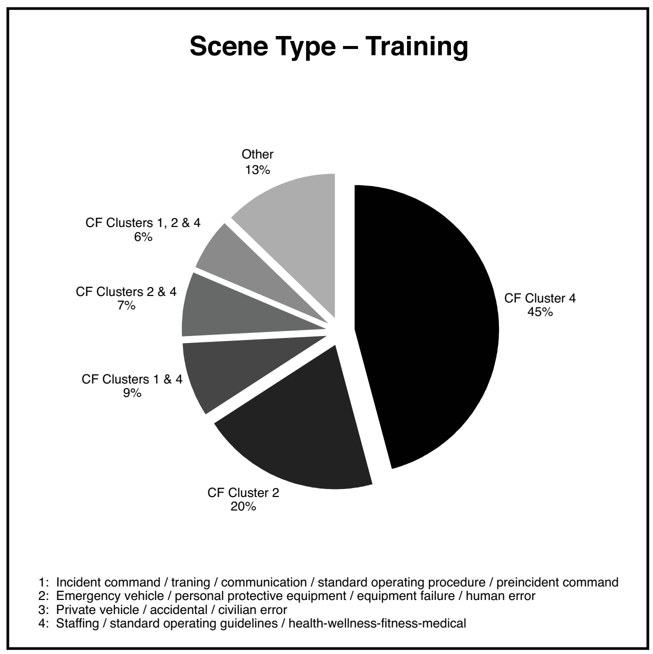


Figure 17. Training



study due to the lack of a control group. However, the cluster analysis does provide evidence of the consistency of factors interacting as seen in Table 4 below.

Table 4. Percent of LODD Contributed by Four Clusters

Cluster	#1	#2	#3	#4
#1	2.33%	6.99%	0.93%	3.11%
#2		14.13%	8.70%	6.06%
#3			3.42%	0.31%
#4				44.72%

Note: About 2.5 percent LODD were due to none of these clusters and additional 6.83 percent LODD were due to more than two clusters and are not listed in this table.

Limitations of Study

There are a number of limitations to the study data, methodology, and findings. LODD cases were compiled from four different databases with varied criteria for inclusion. Cancer deaths considered presumptive, as well as presumptive heart and lung deaths, were excluded from the study due to the length of the death process. This exclusion in turn excluded "exposure" to various contaminants as a contributing factor.

Additionally, the study only explains the factors contributing to LODD that have occurred. Predicting the odds of experiencing a LODD in departments where the identified contributing factors/clusters exist could not be completed because non-mortality data were unavail-

Figure 18. Wildland

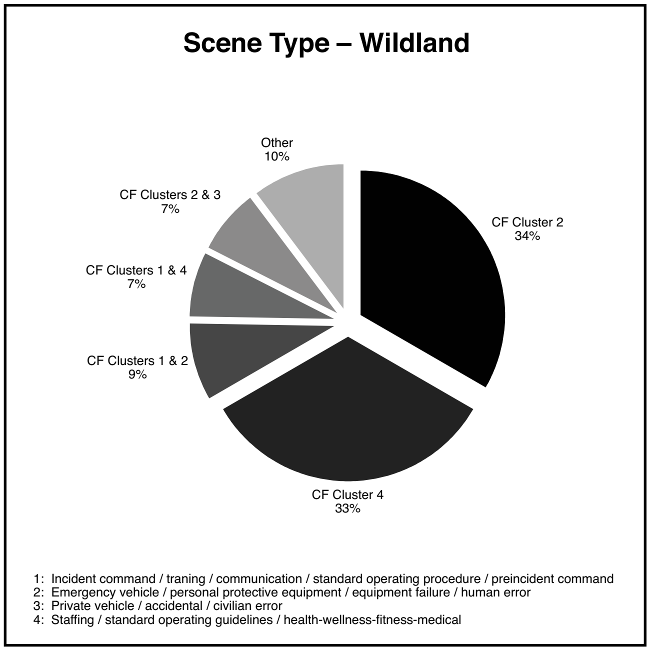
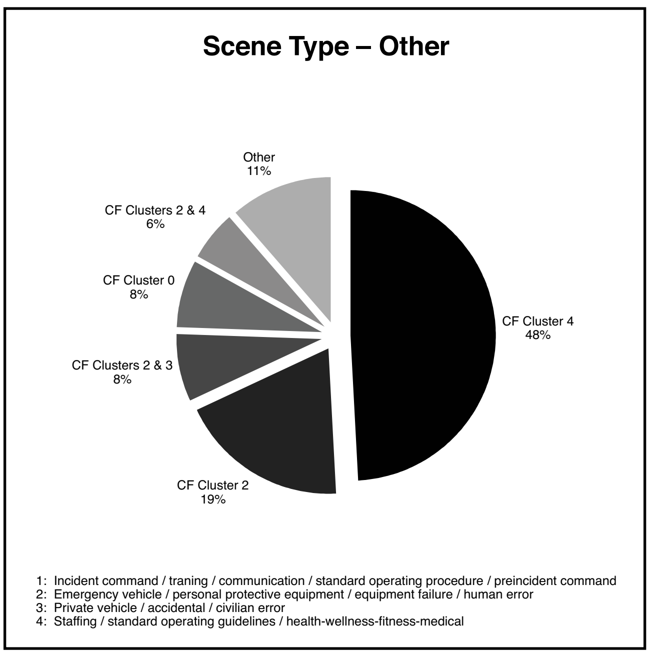


Figure 19. Other On-Duty



able. Likewise, trend analysis could not be completed due to the lack of data on firefighters who did not die on the scenes where a LODD was experienced.

This study only examined LODD without regard to thousands of firefighter line-of-duty injuries that occur daily. Although the study was unable to quantify the impact of these factors on quality of life due to injury, the expectation is that the factors are contributing to line-of-duty injury just as they contribute to LODD. Future studies should attempt the same effort for line-of-duty injury.

Despite the limitations, the results of this study provide a sense of the relative impact of various factors on firefighter LODD in the United States.

Conclusions

Available analysis of the roles of various factors suggests that the most prominent contributing factors to firefighter line-of-duty death in the United States are heath/wellness/fitness/medical status of firefighters, personal protective equipment and human error. When clustered according to contributing factors most often occurring together, the most prominent cluster is crew size, heath/wellness/fitness/medical status of firefighters and standard operating guidelines. Contributing factor clusters identified explain 97.52 percent of firefighter LODD in the United States between the years of 2000-2006. The results presented hold implications for fire department risk management priorities. At the most basic level, they compel examination of the way the fire service tracks near-miss events as well as realized injuries and LODD. It should be noted that the contributing factors identified in this study closely resemble those used in the "Near Miss Project." An accumulation of factors and definitions will be essential to quality data collection and analysis in future studies.

The results also clarify the need to improve the management of contributory factors to reduce on-duty death among America's firefighters. More specifically, the results show a connection between contributing factors and particular firefighter groups so that risk management activities may be directly focused.

Based on the results of this study, recommendations may be made for risk management efforts to interrupt the chain of events leading to a firefighter LODD. These recommendations are not new information to fire service leaders. They have been compiled from scientific literature and the same industry sources that track LODD, including NIOSH investigation reports where contributing factors were identified and recommendations for future avoidance were provided. It is unfortunate that failure to heed these recommendations based on individual firefighter deaths has led to the continuation of more than 100 deaths annually. Collectively, the recommendations from the sources noted are compiled below according to dominant contributing factor clusters. Each recommendation addresses management of a risk factor identified as having contributed to an incident of firefighter LODD.

I. Recommendations for Risk Management of Contributing Factors in Cluster 4

A.) Staffing/Crew Size

a. Provide adequate staffing to ensure safe operating procedures as stated in NFPA® Standard 1500.

b. For Career Departments, implement NFPA® Standard 1710 on Fire Department Staffing and Deployment.

c. For Volunteer Departments, ensure that adequate numbers of staff are available to operate safely and effectively as stated in NFPA® Standard 1720.

d. Ensure that adequate fire control forces and fire suppression equipment are on the scene and available for deployment for fire control activities as outlined in the NFPA® Fire Protection Handbook, 18th Edition, 1997, Section 10/Chapter 1 (p 1-34).

e. Ensure that firefighters who enter a hazardous condition enter as a team of two or more, each with protective clothing and respiratory protection, as recommended in NFPA® Standard 1710 and OSHA, 29 CFR 1910.134 (two-in and two-out).

f. Ensure that at least four firefighters are on the scene before initiating interior fire fighting operations at a structural fire - OSHA, 29 CFR 1910.134 (two-in and two-out).

g. Increase the number of firefighters on engine companies, truck companies and other apparatus to perform in accordance with NFPA® standards 1710 and 1720.

B.) Standard Operating Guidelines

a. Ensure that, whenever a building is known to be on fire and is occupied, all exits are forced and blocked open.

b. Ensure that firefighters conducting a search above a fire notify their officer and take safety precautions to reduce the risk of being trapped.

c. Ensure SOGs addressing emergency scene operations, such as basement fires, are developed and followed on the ground.

d. Ensure that adequate ventilation is established when attacking basement fires.

e. Ensure that vertical ventilation takes place to release any heat, smoke, and fire.

f. Ensure that when entering or exiting a smoke filled structure, firefighters follow a hose line, rope, or some other type of guide and refresher training is provided to reinforce the procedures.

g. Ensure that a lifeline is in place to guide firefighters to an emergency stairwell.

h. Ensure that firefighters open concealed spaces to determine whether the fire is in those areas.

i. Ensure that backup lines are equal to or greater than the initial attack lines.

j. Ensure that ventilation is closely coordinated with the fire attack.

k. Develop SOGs for advancing a hose line in high-wind conditions.

l. Employ thermal imaging technology.

m. Ensure that, whenever there is a change of personnel, all personnel are briefed and understand the procedures and operations required for a particular shift, station, or specific task.

n. Implement an emergency notification system to rapidly warn all persons who might be in danger if an imminent hazard is identified or if a change in strategy is made. Note that in operating guidelines there should be a difference between withdrawing firefighters and calling for an emergency evacuation of firefighters.

o. Use exit locators such as high-intensity floodlights or flashing strobe lights to guide lost or disoriented firefighters to an exit.

p. Ensure that hose lines are not pulled from the burning structure when it is possible that a missing firefighter is in the structure.

q. Instruct firefighters not to overcrowd the area of the initial attack team.

r. Ensure that firefighters establish a protected work area before safely turning their attention to the emergency as stated in IFSTA's *Pumping Apparatus Driver/Operator Handbook* 2nd Edition, 2006.

s. Develop, implement, and enforce standard operating guidelines regarding emergency operations for roadway incidents including procedures for positioning apparatus on the same side of the roadway as the incident.

t. Select and utilize appropriately trained and safe drivers to operate emergency vehicles.

u. Equip apparatus with safety equipment such as additional mirrors, automatic sensing devices, and/or video cameras to assist with backing operations.

v. Utilize National Weather Service Fire Weather Forecasters for all fire weather predictions and immediately share all information about significant fire weather and fire behavior events with all personnel.

w. Ensure that prescribed burn plans are established and approved prior to ignition. (See also Training recommendations.)

x. Ensure that firefighters utilize all available resources when investigating fire activity located in an area that does not have an established escape route.

y. Establish and enforce separate but parallel diver training guidelines along with emergency rescue diving guidelines.

z. Ensure that the department's high-rise SOGs are followed and refresher training is provided.

aa. Develop, implement, and enforce SOGs that address firefighter safety regarding emergency operations for hazardous materials incidents.

bb. Ensure SOGs are developed and utilized when water rescues are performed.

C.) Health/Wellness/Fitness/Medical

a. Phase in a mandatory wellness/fitness program for firefighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity as stated in NFPA® Standard 1500. The program should include medical evaluation/ fitness evaluation along with behavioral rehabilitation and data collection.

b. Conduct mandatory pre-employment (preplacement) and annual medical evaluations and periodic physical examinations consistent with NFPA® Standard 1582 to determine a candidate's medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

c. Incorporate exercise stress tests into the fire department's medical evaluation program as stated in NFPA® 1582, Standard on Medical Requirements for Firefighters and Information for Fire Department Physicians, and the IAFF/IAFC Wellness/Fitness Initiative.

d. Provide firefighters with medical evaluations and determination of clearance to wear self-contained breathing apparatus (SCBA) as stated in the OSHA Revised Respiratory Protection Standard.

e. Clear firefighters for duty by a physician knowledgeable about the physical demands of fire fighting and the various components of the NFPA® Standard 1582.

f. Provide exercise equipment in all fire stations and establish a designated workout time on duty.

g. Preclude from fire fighting activities those individuals with medical conditions that would present a significant risk to the safety and health of themselves or others as stated in NFPA® Standard 1582.

h. Perform an autopsy on all firefighters who were fatally injured while on duty pursuant to the USFA Firefighter Autopsy Protocol.

i. Provide automated external defibrillators (AED's) on fire apparatus and assure that all personnel are trained to use them.

j. Determine if Hepatitis C Virus (HCV) liver disease is of sufficient severity to prevent employees from performing, with or without reasonable accommodation, the essential functions of the job without posing a significant risk to the safety and health of themselves or others.

k. Provide "Communicable Disease Program" consistent with NFPA® 1581: Standard on Fire Department Infection Control Program, and the OSHA Bloodborne Pathogens Standard [29 CFR 1910.1030; 56].

l. Test carboxyhemoglobin levels and test for cyanide poisoning on symptomatic or unresponsive firefighters exposed to smoke to rule out carbon monoxide poisoning.

m. For wildland, check Work Capacity Test (WCT) participant's vital signs before and after testing as stated in the *Work Capacity Test Administrator's Guide* developed by the National Wildlife Coordinating Group, the US Department of Agriculture, and the US Department of the Interior, April 2003.

n. Ensure that firefighters exposed to smoke have access to medical evaluations for urgent treatment if they develop respiratory or any other unusual symptoms.

o. Implement a carbon monoxide-based monitoring program for wildland firefighters to manage their acute overexposure to components of smoke.

p. Provide a member assistance program that identifies and assists members with substance abuse as required by the NFPA®.

II. Recommendations for Risk Management of Contributing Factors in Cluster 2

A.) Emergency Vehicle

a. Establish, implement, and enforce standard operating procedures on emergency vehicle operation.

b. Ensure all drivers of fire department vehicles are responsible for the safe and prudent operation of the vehicle under all conditions.

c. Ensure all drivers of fire department vehicles receive driver training at least twice a year or as often as necessary to meet the requirements of NFPA® Standard 1451, but not less than twice a year.

d. Establish, implement, and enforce standard operating procedures on emergency vehicle operation.

e. Develop comprehensive apparatus maintenance programs and guidelines that include regularly scheduled inspections, documentation, and ensure that all apparatus are taken out of service when defects are identified and are repaired before they are placed in service.

f. Ensure that seat belts for all riding positions are in proper working order prior to each shift and ensure that firefighters wear them.

g. Ensure that fire apparatus are designed and built according to NFPA® standards.

h. Ascertain the age of tires and impose time restrictions for usage according to manufacturers' specifications and guidelines.

i. Ensure that fire apparatus meet the requirements of NFPA® Standards 1901 and 1906 and do not exceed their load-carrying capacity.

j. Ensure that firefighters do not attempt to board moving fire and emergency apparatus.

k. Prohibit members from riding on the tailboard or any exposed position when the vehicle is in motion as stated in NFPA® Standard 1500.

l. Prohibit driving by firefighters less than 18 years of age and revise standard operating procedures accordingly.

m. Determine a safe operating weight for all apparatus based on vehicle characteristics and remove overweight vehicles from service.

n. Avoid retrofitting non-fire service apparatus to serve as tankers, however when necessary, assure that vehicle meets all requirements in NFPA® 1901.

o. Ensure that fire apparatus is positioned to protect firefighters from traffic as stated in NFPA® Standard 1451, Section 8.1.4.1.

p. Ensure that forest service apparatus comply with NFPA® 1906.

q. Ensure that forest service ATV's are equipped with threaded fuel caps, fuel tank venting and overflow tubes. Consider replacement of older narrow track ATV's and installation of rollover protection on ATV's.

B.) Personal Protective Equipment

a. Ensure that personnel on board emergency and fire apparatus are seated, belted, and accounted for, prior to movement and that all persons are secured by seat belts, or safety restraints, at all times the vehicle is in motion.

b. Ensure that personnel being transported when on-duty, be securely seated and restrained in approved vehicle passenger compartments. Prohibit members from riding on the tailboard or any exposed position when the vehicle is in motion.

c. Ensure that donning or doffing of equipment and personal protective clothing that requires removal of any restraining devise is prohibited while the vehicle is in motion.

d. Ensure that firefighters properly don and wear their personal protective equipment at all times while working in a hazardous environment.

e. Ensure that each firefighter is equipped with a full protective clothing ensemble and a Self Contained Breathing Apparatus (SCBA) and that periodic training is conducted on the donning of such equipment.

f. Ensure that SCBA manufacturer guidelines are followed in training and use of such equipment.

g. Provide firefighters with medical evaluations to determine fitness to wear a SCBA as mandated in OSHA: Revised Respiratory Protection Standard prior to issue and certification on such equipment.

h. Establish written standard operating procedures that ensure record keeping annual evaluations to monitor and evaluate the effectiveness of the overall SCBA maintenance program.

i. Provide training to firefighters on the use of SCBA including management of air supply, field maintenance and emergency procedures.

j. Ensure that fire suppression personnel wear their SCBAs whenever there is a chance they might be exposed to a toxic or oxygen-deficient atmosphere, including the initial assessment.

k. Provide SCBA face pieces that are equipped with voice amplifiers for improved interior communications.

l. Ensure firefighter use of PASS devices.

m. Where applicable, provide firefighters with wildland appropriate NFPA® 1977 compliant personal protective equipment and appropriate wildland firefighter training.

n. Ensure that personnel wear NFPA® compliant personal protective clothing that is suitable to the incident while operating at an emergency scene, such as structural fire, wildland fire, water rescue and roadway incidents.

o. Ensure that firefighters and EMS personnel wear ANSI compliant roadway safety vest while operating on the roadway.

p. Place firefighter identification emblems on the firefighter's helmet and turnout gear.

q. Provide and train personnel on the use of body armor PPE when responding to potentially violent situations.

r. Provide and enforce the use of PPE during airbag demonstrations.

C.) Emergency Equipment Failure

a. Ensure that all firefighters riding in emergency fire apparatus are wearing and are properly belted and secured by seat belts.

b. Ensure that routine apparatus maintenance includes document inspections of restraints in all seating areas.

c. Ensure that all apparatus are kept under a comprehensive documented maintenance program.

d. Develop comprehensive apparatus maintenance programs in accordance with manufacturer's specifications and DOT regulations. Provide policy that includes regularly scheduled inspections, documentation and procedures for removing apparatus from service until defects are repaired.

e. Ensure that fire apparatus are designed and built according to applicable NFPA® standards.

f. Ensure that interior crew and driving compartment door handles are designed and installed to protect against inadvertent opening.

g. Incorporate specifics on rollover prevention in standard operating procedures and driver training as stated in NFPA® 1451 § 5.3.

h. Ascertain the age of tires and impose time restrictions for usage according to manufacturer's specifications and guidelines.

i. Incorporate specifics on maintaining vehicle control when a rapid loss of tire pressure occurs.

j. Ensure that fire apparatus meet the requirements of NFPA® Standards 1901 and 1906 and do not exceed their load carrying capacity.

k. Determine a safe operating weight for fire apparatus based on vehicle characteristics and remove overweight vehicles from service.

D.) Human Error

a. Enforce standard operating procedures on the mandatory use of seat belts in all emergency vehicles.

b. Ensure that all persons responding in emergency apparatus are wearing and secured by seat belts or safety restraints in approved vehicle passenger compartments at all times the vehicle is in motion.

c. Firefighters should ensure that a proper size-up is conducted before performing any rescue operations, and applicable information is relayed to the officer in charge.

d. Enforce the requirement that all firefighters wear their SCBA whenever there is a chance they might be exposed to a toxic or oxygen-deficient atmosphere.

e. Ensure that hose lines are not pulled from the burning structure when it is possible that a missing firefighter is in the structure.

f. Ensure that team continuity is maintained.

g. Ensure that firefighters are trained on actions to take while waiting to be rescued if they become lost or trapped inside a structure.

h. Ensure that all drivers of fire department vehicles are responsible for the safe and prudent operation of the vehicles under all conditions. Drivers should be familiar with the potential hazards/conditions that exist on the roadways on which they may travel. Drivers should always maintain safe speeds to avoid losing control of their vehicles.

i. Ensure that all drivers of fire department vehicles receive driver training at least twice a year and that operators understand the vehicle characteristics, capabilities, and limitations.

j. Provide training to driver/operators as often as necessary to meet the requirements of NFPA® Standards 1451, 1002, and 1500.

k. Ensure drivers/operators of emergency vehicles make a complete momentary stop when entering an intersection against a red light, stop sign, or when the lights are changing.

l. Ensure drivers drive at speeds appropriate for weather and road conditions.

m. Prohibit any member of the fire department from responding to a call if they have been drinking or have a blood alcohol above 0.0.

n. Prohibit firefighters from riding on the tailboard or any exposed position when the vehicle is in motion.

o. Prohibit firefighters from donning or doffing equipment or personal protective clothing that requires removal of any restraining device while the vehicle is in motion.

p. Prohibit driving by firefighters less than 18 years of age.

q. Develop standard operating procedures for the use of Privately Owned Vehicles (POV) for emergency response and provide training on the standard operating procedures to firefighters in all new-member orientation and driver training sessions.

r. Provide firefighters, including junior firefighters, with hazard awareness that includes unique hazards that may be encountered when using unconventional means of transportation (bicycles, scooters, etc.) to respond or return from fire alarms.

s. Train emergency dispatchers to obtain as much information as possible from the caller and report it to the responding firefighters.

t. Ensure that firefighters properly don and wear their personal protective clothing at all times while working in a hazardous environment.

u. Ensure that prior to working on a prescribed burn for training or for a wildland event, all personnel involved receive and understand their assignment.

v. Ensure that prior to demonstrations of rescue airbags, all personnel are trained in the safe procedures necessary to use or demonstrate these devices.

w. Prohibit firefighters from engaging in the ignition of fireworks displays unless trained and certified as pyrotechnic professionals.

x. Ensure that firefighters are trained on ladders and that ladders are used in accordance with existing safety standards.

III. Recommendations for Risk Management of Contributing Factors in Cluster 3

A.) Privately Owned Vehicle

a. Develop standard operating procedures for the response of off-duty firefighters in their privately owned vehicle (POV) to interstate highway incidents as stated in NFPA® Standard 1500, Sections 6.2.3 and 6.2.3.1.

b. Develop standard operating procedures for the use of POVs for emergency response and provide training on the procedures to firefighters in all new-member orientation and driver training sessions as stated in NFPA® Standard 1500, Section 6.2.3.

c. Ensure drivers operate POV at speed limits or less as appropriate for the conditions to prevent loss of vehicle control.

d. Ensure drivers with emergency or courtesy warning lights used in their POV have been appropriately trained in their use and restrictions.

B.) Accidental

a. Municipalities should consider adopting public service announcements/training for driver safety to promote safe driving by the public and should encourage motorists to pull to the right when approached by responding emergency vehicles.

C.) Civilian Error

a. Ensure that fire apparatus are positioned to protect firefighters from oncoming traffic as stated in NFPA® Standard 1451, Section 8.1.4.1.

b. Train personnel in safe procedures for operating in or near moving traffic.

c. Ensure placement of various types of warning devices to inform drivers that they are approaching an incident scene.

d. Use flaggers on or near the shoulder of the roadway upstream from the incident scene to stop and/or control the flow of traffic near an accident scene.

e. Work with local DOT to disseminate traffic control and road condition information to motorists utilizing local commercial and public radio and television broadcasts.

f. Develop, implement, and enforce SOPs/SOGs regarding emergency operations for roadway incidents including procedures for positioning apparatus.

g. Inspect and enforce local guidelines for storage of hazardous materials in all commercial occupancies.

h. Consider all tanks hazardous unless they have been tested and found safe, cleaned, or rendered inert.

i. Prohibit welding or cutting operations in the presence of explosive atmospheres.

IV. Recommendations for Risk Management of Contributing Factors in Cluster 1

A.) Incident Command

a. Establish and implement an Incident Command System (ICS) with written standard operating procedures for all firefighters.

b. Ensure that the department's standard operating procedures are followed.

c. Ensure that first arriving company officer does not become involved in fire fighting efforts when assuming the role of IC.

d. Ensure that accountability for all personnel at the fire scene is maintained.

e. Ensure that crews stay together at all times.

f. Ensure that a method of fire ground communication is established to enable coordination among the IC and firefighters.

g. Ensure that positive communication is established among all divers and those personnel who remain on the surface.

h. Ensure that orders given by the IC are followed and all tasks completed are reported to the IC.

i. Ensure that the IC conveys strategic decisions to all suppression crews on the fireground and continually reevaluates fire conditions.

j. Ensure that offensive and defensive fire suppression strategies are not simultaneously conducted.

k. Ensure that firefighters do not oppose hose lines when performing an internal or external attack.

l. Ensure that an assessment of the stability and safety of the structure is conducted before entering fire and water damaged structures for overhaul.

m. Establish and monitor a collapse zone to ensure that no activities take place within this area as part of overhaul operations.

n. Ensure all prescribed burn operatives have a designated IC.

o. Ensure that prior to the operational period all personnel involved in the prescribed burn operation receive and understand their assignment.

p. Ensure that authority to conduct firing out or burning out operations is clearly defined in the SOP and is closely coordinated with all supervisors, command staff and adjacent ground forces.

q. Ensure that all personnel, especially those operating at or near the head of a wildland fire, are provided with current and anticipated weather information.

r. Train officers and firefighters on the hazards associated with different types of confined spaces (e.g. silos) and the appropriate fire fighting tactics.

B.) Training

a. Ensure that all firefighters and line officers receive annual refresher training regarding structural fire fighting.

b. Establish and implement an orientation and training program for all newly appointed, promoted, or reassigned officers.

c. Ensure that firefighters are trained to recognize that they are operating above a fire and the associated dangers.

d. Train firefighters not to overcrowd the area of the initial attack team.

e. Establish and maintain training programs for emergency scene operations.

f. Ensure that all firefighters receive training equivalent to the NFPA® Firefighter Level I certification.

g. Ensure that all wildland firefighters receive training equivalent to NFPA® wildland firefighter Level 2 certification. Ensure that all wildland firefighters are provided at a minimum with personal protective equipment that is NFPA® Standard 1977 compliant.

h. Train firefighters on actions to take while waiting to be rescued if they become lost or trapped inside a structure. Before a controlled burn training exercise takes place, ensure that all the requirements of NFPA® Standard 1403 have been met.

i. Ensure all drivers of fire department vehicles receive driver training twice a year. Ensure that SOPs are developed, followed and refresher training is provided.

j. Ensure that firefighters are properly trained before operating new equipment.

k. Train personnel in safe procedures for operating in or near traffic.

l. Train personnel in emergency operations for roadway incidents.

m. Train personnel in specifics on intersection practices.

n. Train personnel on maintaining vehicle control when a rapid loss of tire pressure occurs.

o. Ensure that an experienced backup diver, a safety boat, extra air tanks, and a medical unit is on the scene of all training dives; ensure that dive search and rescue operations establish and use reference points to conduct searches; and ensure that in the event that trained designated diver rescue personnel are not available, firefighters are trained in the "reach, throw, row and go" rescue technique and are properly trained to perform water rescues.

p. Provide firefighter training on railway traffic safety in communities where a high density of railway traffic exists.

q. Implement joint training on response protocols with mutual aid departments to establish interagency knowledge of equipment, procedures, and capabilities.

r. Periodically provide defibrillator unit refresher training.

s. Train firefighters on proper radio discipline and operation, and on when and how to initiate emergency traffic when in distress.

t. Ensure that public safety dispatchers are properly trained to provide all necessary information to emergency response agencies.

u. Train all firefighters and employees expected to use or demonstrate rescue airbags in the safe procedures necessary to use or demonstrate these devices.

C.) Communications

a. Ensure that fire ground communication is present through both the use of portable radios and face-to-face communications.

b. Ensure that a method of fire ground communication is established to enable communication among the IC and firefighters.

c. Ensure those firefighters who enter hazardous areas are equipped with two-way communications with Incident Command.

d. Provide NFPA® compliant portable radios as stated in NFPA® Standard 1221, Section 6-3.6.

e. Provide adequate on-scene communications including tactical channels as stated in NFPA® Standard 1561.

f. Establish and maintain multiple operating frequencies for emergency services, allowing portable radios at incidents to be equipped with two frequencies, one channel for tactical messages and one channel for command.

g. Emphasize the importance of communication and accountability on the fireground, particularly to firefighters with minimal fireground experience.

h. Consider providing all firefighters with portable radios or radios integrated into their face pieces.

i. Provide SCBA face pieces that are equipped with voice amplifiers for improved interior communications.

j. Review dispatch/alarm response procedures with appropriate personnel to ensure the processing of alarms is completed in a timely manner as stated in NFPA® Standard 1221.

k. Develop integrated emergency communication systems that include the ability to relay real-time information between the caller, dispatch, and all responding emergency personnel.

l. Ensure communication 'operability' between firefighters within a department.

m. Establish and maintain regional mutual-aid radio channels (interoperability) to coordinate and communicate activities involving units from multiple jurisdictions.

n. Ensure that local citizens are provided with information on fire prevention and the need to report emergency situations as soon as possible to the proper authorities.

o. Ensure that the radio in the driving compartment is within convenient reach for the driver.

p. Ensure that positive communication is established among all divers and those personnel who remain on the surface; and ensure that divers maintain continuous visual, verbal, or physical contact with their dive partner as stated in OSHA Standard, 29 CFR 1910.424(C)(2).

D.) Standard Operating Procedures

a. Establish and implement an Incident Command System (ICS) with written standard operating procedures for all firefighters. All fire department personnel should be thoroughly trained on this system and receive periodic refresher training, and all training should be documented.

b. It is imperative that companies perform their duties as described in the SOP/SOGs unless directed or approved by the ICS to do otherwise.

c. Ensure that accountability for all personnel at the fire scene is maintained.

d. Ensure that Personnel Accountability Reports (PAR) are conducted in an efficient, organized manner and results are reported directly to the IC.

e. Develop SOPs for buildings constructed of lightweight roof trusses.

f. Ensure supervisors remain accountable for all who operate under their supervision and ensure that a team continuity of at least two firefighters is maintained.

g. Develop, implement, and enforce standard operating procedures to address the treatment of injuries on-site that include guidelines for evaluating injuries that are not obviously life threatening, based on protocols developed in coordination with the local EMS provider and the Department's Physician and Chief.

h. Adopt the International Association of Fire Chief's zero tolerance policy for alcohol and drinking to prohibit the use of alcohol by members of any fire or emergency services agency organization at any time when they may be called upon to act or respond as a member of those departments including reporting for duty with a 0.0 blood alcohol level. Develop written policies and have procedures in place to enforce this policy.

i. Establish, implement, and enforce SOPs on emergency vehicle operation; ensure drivers/operators of emergency vehicles follow SOPs by making a complete stop at all intersections; enforce SOPs on the use of seat belts in all emergency vehicles.

j. Develop, implement, and periodically review standard operating procedures for backing fire apparatus and equip apparatus with safety equipment such as additional mirrors, automatic sensing devices, and/or video cameras to assist with backing operations.

k. Develop SOPs for the response of off-duty firefighters in their privately owned vehicles to interstate highway incidents as stated in NFPA® 1500, Sections 6.2.3 and 6.2.3.1.

l. Ensure that fire apparatus is positioned to protect firefighters from traffic as stated in NFPA® Standard 1451; Section 8.1.4.1.

m. Develop, implement, and enforce SOPs regarding emergency operations for roadway incidents including procedures for positioning apparatus.

n. Develop SOPs for filling engine water tanks.

o. Prohibit members from riding on the tailboard or any exposed position when the vehicle is in motion as stated in NFPA® Standard 1500.

p. Develop, implement, and periodically review SOPs for backing fire apparatus.

q. Develop and enforce SOPs for seat belt usage.

r. Develop and enforce SOP for driver intersection practices.

s. Develop and enforce SOP for response with mutual/automatic aid.

t. Ensure that personnel engaged in wildland fire fighting follow the 10 standard fire orders developed by the National Wildfire Coordinating Group. (NWCG Handbook 3, March 2004)

u. Ensure that a designated lookout is positioned at a location that allows the observation of fire activity on the prescribed burn.

v. Ensure that prior to the operational period all personnel involved in the prescribed burn operation receive and understand their assignment.

w. Ensure all prescribed burn operations have a designated IC.

x. Ensure that firefighters attack a brush fire from a safe place on the apparatus or walk alongside the moving apparatus.

y. Ensure that all training exercises are conducted in accordance with NFPA® Standard 1403.

z. Ensure that adequate traffic control is in place before turning attention to the emergency.

aa. Incorporate, at a minimum, Standard 29 CFR 1910, for commercial diving operations into the fire department's diving SOPs.

bb. Develop SOPs for potentially violent situations.

cc. Prohibit driving by firefighters less than 18 years of age.

dd. Develop SOPs to specify permissible and non-permissible tasks and activities for youth members participating in junior fire service programs.

E.) Pre-Incident Planning

a. Develop a pre-incident planning program consistent with NFPA® 1620.

b. Conduct pre-incident planning and inspections to facilitate development of a safe fireground strategy.

c. Develop and implement a system to identify and mark dangerous and/or abandoned structures.

d. Educate the public on the importance of building owners, building personnel, or civilians to immediately report any fire conditions to the first-arriving fire company on the scene.

e. Ensure that all building utilities are indicated on pre-plan.

f. Establish a system to facilitate the reporting of unsafe conditions or code violations observed by firefighters during fire suppression activities.

g. Enforce current and applicable building codes to improve the safety of occupants and firefighters.

h. Advocate/lobby municipalities to upgrade and modify older structures to incorporate new codes and standards to improve occupancy and firefighter safety.

i. Coordinate with police and if applicable state and local DOT to develop and implement pre-incident plans regarding traffic control for emergency incidents.

j. For wildland fire fighting, ensure that high-risk geographic areas are identified as part of the pre-incident planning process and ensure that information is provided to assigned crews including maps, a list of specialized concerns/needs and a history of previous fires.

k. Ensure that pre-emergency planning is completed for confined space structures within a jurisdiction.

Policy Development/Alteration Process

Year after year, approximately 100 firefighters are killed in the line of duty. If heeded, the results of this project can reduce these on-duty firefighter fatalities. This project is a precursor to a collaborative effort underway by the IAFC Health and Safety Committee known as the "Vulnerability Project." The outcomes and recommendations of this risk management project will be provided to the IAFC Committee for expansion and implementation within their project tasks. In fact, the results of this project are a necessary part of the overall "Vulnerability Project" as it attempts to implement the risk management recommendations noted.

There can be no illusions about the difficulty of the challenges in changing the impact of some of these contributing factors, particularly those related to personal behavior. However, the Fire Services' efficiency in changing the annual death toll of America's firefighters is dependent on its ability to identify and manage the risks associated with the clusters of contributing factors identified.

Future Policy Analysis Research

If a significant reduction in firefighter LODD is to be realized, fire service leaders must focus directly on the contributing factors to death as identified. Future research should compare the incidence of LODD before and following wide implementation of risk management programs based on known risk (contributing factors) to LODD. Additionally, future studies should identify data sources for on-duty injury in order to conduct the same assessment for line-of-duty injury.

In regards to the Health/Wellness/Fitness/Medical contributing factor, the current body of knowledge reflects a piecemeal approach to evaluating interventions. Future research should include characterizing the firefighting environment using industrial hygiene methods, evaluating selected injuries for causes, and testing limited interventions for impact on health behaviors. Although there are industry standards in the fire service that address desirable components of occupational health and wellness programs, there are no data available regarding the most efficient methods for implementing such programs. Likewise, data regarding the impact of these programs on outcomes such as injury rate, return-to-work rate following injury and lost days due to illness are limited. Finally, there are only sparse data regarding the impact of specific programs to optimize personal health practices such as exercise, nutrition and smoking cessation.

Notes

[1]Department of Justice (DOJ) Ruling, September 11, 2006. The DOJ issued new rules under the Public Safety Officer Benefits (PSOB) program including hearth attack and stroke. The new regulations provide that if a public safety officer dies as a result of a heart attack or stroke, the death may be presumed to have been the result of a personal injury sustained in the line of duty. The law requires that the heart attack or stroke occur while the officer is on duty and engaged in an emergency response activity or training exercise or within 24 hours of such activity or exercise.

[2]NFPA® Standard 1710

[3] The maps can be provided upon request. Please send your request to bob.england@okstate.edu.

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National Fire Protection Association Master Glossary of Terms, as used in the following standards:
NFPA® 80, *Standard for Fire Doors and Other Opening Protectives*
NFPA® 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*
NFPA® 402, *Guide for Aircraft Rescue and Fire-Fighting Operations*
NFPA® 424, *Guide for Airport/Community Emergency Planning*
NFPA® 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*
NFPA® 600, *Standard on Industrial Fire Brigades*
NFPA® 601, *Standard for Security Services in Fire Loss Prevention*
NFPA® 1003, *Standard for Airport Fire Fighter Professional Qualifications*
NFPA® 1410, *Standard on Training for Initial Emergency Scene Operations*
NFPA® 1521, *Standard for Fire Department Safety Officer*
NFPA® 1581, *Standard on Fire Department Infection Control Program*
NFPA® 1584, *Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises*
NFPA® 1620, *Recommended Practice for Pre-Incident Planning*
NFPA® 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*
NFPA® 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*
NFPA® 1982, *Standard on Personal Alert Safety Systems (PASS)*

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American Fire Stations and 24-hour Shifts: Breeding Grounds for Problems from Groupthink?

Abstract

Firefighters operate effectively in teams under dangerous emergency conditions at all hours of every day to save lives and protect property. During the idle times between fire and rescue alarms, however, many fire stations in the United States can harbor the social group dynamics conditions contributing to the faulty decision making first identified as "groupthink" by psychologist Irving Janis about 35 years ago. Janis described groupthink as the problem of groups prematurely conceding to a decision before properly considering all options, a potential problem that is positively influenced by strong group cohesiveness. A high degree of cohesiveness is necessarily present in fire fighting teams, and fire station lifestyles provide other important conditions that facilitate groupthink.

Introduction

Irving Janis (1972) coined the term "groupthink" and elaborated on it in the second edition of his book (1982) *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*. Janis (1972) said he used the term groupthink "to refer to a mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternate courses of action" (p. 9). He used well-known examples of the day to illustrate fiascoes resulting from groupthink, including the Kennedy Administration's Bay of Pigs invasion, the decisions to escalate the Korean War and the Vietnam War, ignoring warning signs of the Pearl Harbor attack, and the Watergate break-in coverup. Janis' theoretical model of groupthink is shown in Figure 1. We may ask: Can such faulty group thinking can be found in the fire service?

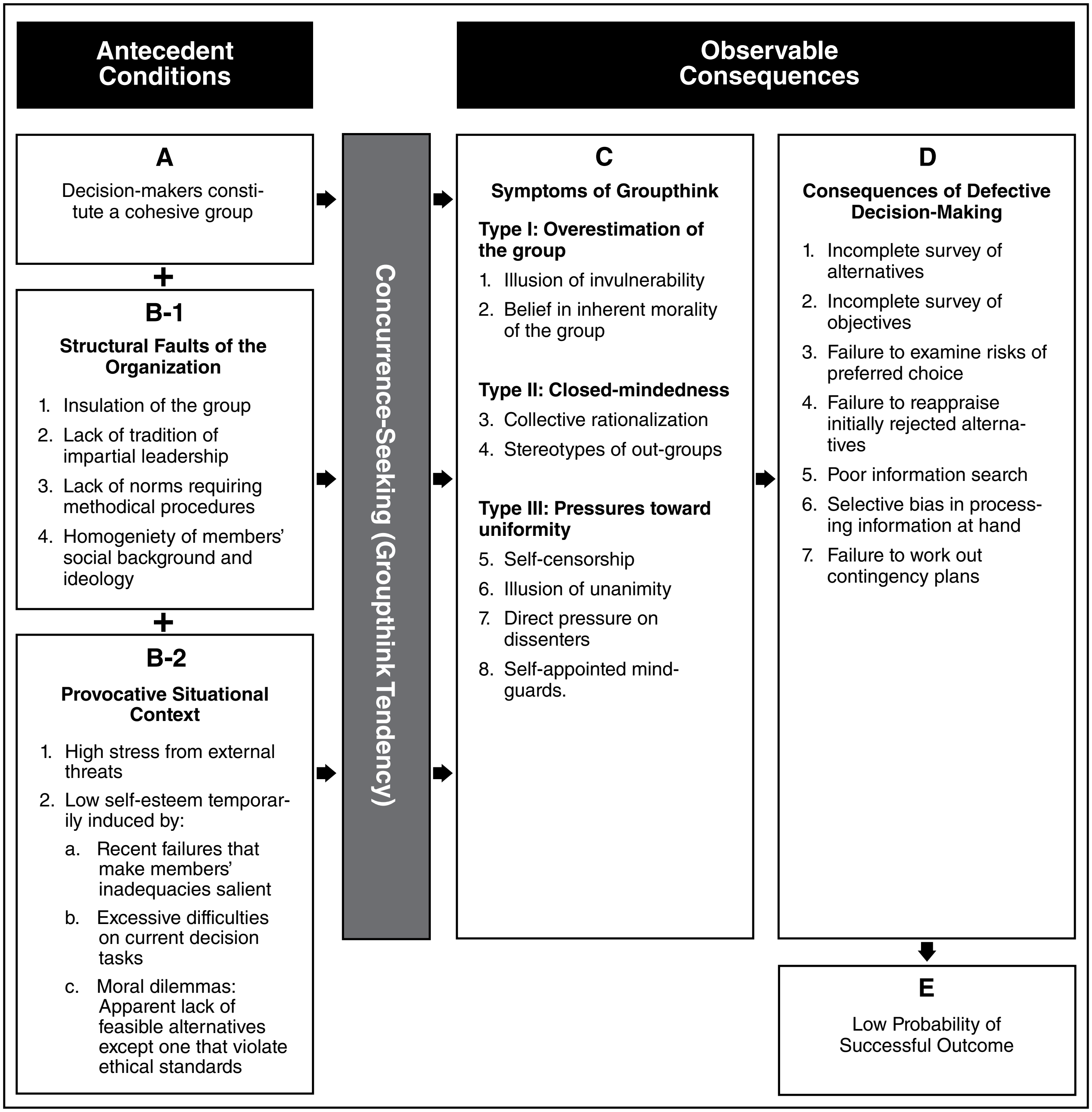
The Janis (1972) illustrations of groupthink were highly visible examples of faulty decisions by large, high-level groups, but groupthink can take hold in much smaller groups, including fire fighting teams at fire stations throughout the United States. Janis added that "Groupthink refers to a deterioration of mental efficiency, reality testing, and moral judgment that results from in-group pressures" (p. 9). He created high interest in this new way of looking at troubling group decisions. It was not supposed to be this way when individuals joined together. Groups were supposed to have the protection of numbers, where more minds were available to work together to make better decisions, not worse ones. If a group member, even the leader, seemed ready to make a faulty decision affecting the group's welfare, there was supposed to be the backup of other members to declare a warning.

This paper relates the durable Janis concepts of in-group cohesiveness, deterioration of mental efficiency, and in-group pressures to fire stations operating on 24-hour shifts in the United States. Among fire department administrators and their political leaders, groupthink is rarely considered as a threat to fire fighter function and security or to the positive image of a fire department, but fire stations can be seen as breeding grounds for the detrimental effects of groupthink originating during the idle hours of a 24-hour shift. Examples discussed here are limited by space to include inappropriate group sexual activity in fire stations, inappropriate use of alcohol in fire stations, and tragically unsafe group decisions related to dangerous training fires. With further analysis, it is possible that groupthink could be applied to the tragic and fatal events of 2007 at the Charleston (SC) Fire Department. In view of the documented damage from selected fire station groupthink consequences, fire department administrators should have a better understanding of the conditions, danger, and prevention of groupthink in outpost fire stations.

Groupthink Foundations and Symptoms

Forsyth (1999) summarized Janis to describe four foundation conditions supporting groupthink, including group cohesiveness, isolation, directive leadership, and decisional stress. Janis (1972) called group cohesiveness "the central part of my analysis" (p. 4) and said it has been long known "that group solidarity increases markedly whenever a collection of individuals faces a common source of external stress, such as the threat of being injured or killed" (Janis, 1982, p. 4). His example of external stress was military combat, but it can be argued that firefighters working shifts of a continuous 24 hours in an outpost fire station, ready at any moment to meet any hazardous challenge that occurs anywhere in the assigned territory, become the most cohesive

Figure 1: Theoretical Analysis of Groupthink



Source: *Groupthink: Psychological studies of policy decisions and fiascoes*, Irving L. Janis (1982, p. 244)

in-groups anywhere short of a military unit in combat. Indeed, firefighters in the United States engage in a special community combat duty. They may risk their own lives to save the life of a stranger. According to the National Fire Protection Association (Fahy & LeBlanc, 2006), 103 firefighters died on duty in 2004, with an average of 100 on-duty deaths per year for the previous 10 years, excluding the losses from the World Trade Center collapse in 2001. The National Fire Protection Association estimates that firefighters suffered more than 75,000 injuries in the line of duty in 2004 (Karter & Molis, 2005).

In summarizing his position on the importance of cohesiveness as a foundation of groupthink, Janis (1982) said that, "The more amiability and esprit de corps among the members of a policy-making in-group, the greater is the danger that independent critical thinking will be replaced by groupthink, which is likely to result in irrational and dehumanizing actions directed against out-groups" (p. 13). Fire service leaders should not be able to read this quote without thinking of the fire station environment and the potential for harm to fire department public relations whenever any irresponsible group behavior is allowed to propagate.

Although Janis referenced policymaking groups, this summary can be seen to apply to fire fighting teams in outpost fire stations for the way they operate independently between alarms and, in effect, can apply ad hoc policies. An outpost fire station is here defined as any station operating at a distance from the fire department headquarters offices. Meanwhile, the uniqueness of fire fighting duty and the personal risk involved produces an attitude that anyone not a member of the fire fighting team is by definition an out-group. This may include members of the public (especially racial minorities and females), controlling members of fire department administration, and political leaders.

Cohesiveness is an essential part of the foundation of groupthink, but Janis reminded that it does not serve as the sole or automatic cause of groupthink by itself. He warned that cohesive groups do not always resort to groupthink. If group cohesiveness remains a foundation antecedent for groupthink to occur, other antecedents also play a role in creating or supporting groupthink.

Insulation from outside influences is another foundation of groupthink (Janis, 1982, p. 248). Fire stations are special-function buildings that operate 24 hours a day, but usually do not conduct other public business. They are operated like households, with living quarters and work areas, and outsiders can feel like intruders. Citizens rarely have any reason to enter a fire station. An outpost fire station's unique task specialization typically leaves members isolated from other government buildings and citizens. The homogeneity of fire department members' social background and ideology contributes to insulation. The fire crew members are often overwhelmingly alike: most are white males, have the same level of education (high school graduation), receive the same basic firefighter training, tend to have the same types of outside interests and hobbies, are skilled with tools and comfortable with manual labor, and are conservative politically.

Directive leadership is a third foundation of groupthink. The fire service does not have a tradition of impartial leadership. Fire fighting is organized around a paramilitary model useful for response to emergency incidents, where instant action and predictable, ingrained reactions of every member are required during an emergency for safety reasons. A crew leader at a fire issues an order and it must be complied with, generally without question. Such leadership is never impartial but operates under authority from experience and rules. It is true that life back at the fire station is more relaxed and does not require continual application of the paramilitary model, but that directive style becomes ingrained in fire crew leadership even at stations. Decisional stress is a fourth foundation for groupthink and is a common result of the risks of fire fighting. In general, firefighters live with the awareness that the next alarm to an unknown emergency might increase their chance for injury or death. Specific decisional stress is also felt when the firefighter group faces moral dilemma choices involving sex and alcohol that may violate departmental, societal, or individual ethical standards.

These foundations of groupthink do not directly cause defective decisions, but defective decisions are more likely to accompany an increase of concurrence-seeking in the group, which increases pressures for individuals, especially new members, to go along and get along with the existing group. All of the foundation conditions combine to tilt the group more toward groupthink until it does occur.

Forsyth (1999) summarized eight symptoms of groupthink, which can be considered in the fire service environment: (1) interpersonal pressure, (2) self-censorship, (3) mindguards, (4) apparent unanimity, (5) illusions of invulnerability, (6) illusions of morality, (7) biased perceptions of the outgroup, and (8) defective decision-making strategies. Interpersonal pressures for conformity and cohesiveness "make agreeing too easy and disagreeing too difficult. Tolerance for any sort of nonconformity seems virtually nil, and groups may use harsh measures to bring those who dissent into line" (Forsyth, 1999, p. 326). This certainly applies to fire station culture for the way new recruits are socialized into the system dominated by senior members. Janis coined the term "mindguard" to describe the person who seeks to enforce conformity by "putting social pressure on any member who begins to express a view that deviates from the dominant views of the group, to make sure that he will not disrupt the consensus of the group as a whole" (Janis, 1972, p. 41). This is a common condition in fire stations when groups live together for 24-hour shifts. Many firefighters, especially more junior members at a fire station, willingly apply self-censorship as part of being accepted by the group. Myers (2005) studied assimilation of firefighter recruits into the fire station group and said "more experienced firefighters come to evaluate recruits as trustworthy when the newcomer demonstrates deference" (p. 375). Deference leads to self-censorship. Myers added that "some socialization researchers assert that assimilation occurs when organizational newcomers relinquish their individuality and conform to organizations' expectation" (p. 348). No one wants to destroy the unity of the group, but this creates only an apparent unanimity of the group. Janis said this helps to protect the self-esteem of the group members who are reluctant to be criticized collectively by the group. The unanimity is only an illusion, but "without it, the sense of group unity would be lost, gnawing doubts would start to grow, confidence in the group's problem-solving capacity would shrink, and soon the full emotional impact of all the stresses generated by making a difficult decision would be aroused" (Janis, 1972, p. 205). Operating on 24-hour shifts only serves to increase the forces of conformity.

In similar ways, when the group maintains an illusion of invulnerability, even as they begin to make a bad decision, they are exhibiting a symptom of groupthink. This illusion of invulnerability can be somewhat helpful to sustain confidence in hazardous fire fighting situations, but back at the fire station it can mask bad decisions. According to Forsyth (1999), “the feeling that all obstacles can be easily overcome through power and good luck tends to cut short the importance of clear, analytical thinking in decision-making groups” (p. 327).

Illusions of superior morality further illustrate groupthink. When the illusion is unquestioned, said Janis, group members are more inclined to ignore moral and ethical consequences of their actions. The bravery and losses of New York firefighters on September 11, 2001, supported the subsequent illusion of superior morality of the entire American fire service. A BBC reporter explained that “The United States has always had its heroes — those who won the war of independence, cowboys, railway builders, industrialists, baseball players…but since 11 September, firefighters have become the nation’s new idols” (Winter, 2001). Closely related to the “we’re heroes, we can do no wrong” illusion is a biased perception of the outgroup. As Janis explained it, “Deflection of anger away from group members is typical behavior for a frustrated leader who is loyal to his in-group” (1972, p. 68). Outgroups become the easy alternate target.

Defective decision-making strategies can often seem obvious when, after the results can be seen, such terms as “fiasco,” “blunder,” and “debacle” are publicly applied (Forsyth, 1999). Many of the defective decisions made by fire department teams at fire stations have become associated with these terms when the results of the decisions become public. Groupthink was originally applied to public policy fiascoes, but it has since been applied to numerous group decision patterns in a variety of settings.

The groupthink theory has not been broadly applied to fire station groups previously. Johnson and Weaver (1992) demonstrated the possible existence of groupthink in unexpected places. They specifically matched groupthink to the postsecondary classroom, which usually involves a leader who is directive and influential and who attempts to create a cohesive group, with somewhat insulated students operating under a high degree of stress and who had an inefficient procedure for gathering independent information and interpreting it, with a tendency to avoid challenging the leader’s pronouncements. Similarities exist here with fire service training activities. Johnson and Weaver (1992) conclude that “students are trained to accept as natural and typical the antecedent conditions of groupthink,” and “the groupthink mode of decision-making may follow quite naturally for adults who have grown up with years of comfort experiencing those conditions that allow, even foster, such behavior” (p. 103).

It should be noted that while the idea of groupthink has caused considerable interest over a long period of time, there has been concern and even disagreement with Janis’s methods and results. Neck and Moorhead (1995) remarked, “Considering the popularity of the concept, the scarcity of research examining its propositions is startling” (p. 538). They concluded that “the original framework proposed by Janis is an incomplete explanation for the occurrence of groupthink in small groups” (p. 555). Aldag and Fuller (1993) reviewed extensive literature available at the time and observed that “the groupthink phenomenon has been accepted more because of its intuitive appeal than because of solid evidence” (p. 547). They said the definition of groupthink “invites the search for confirming evidence,” but reminded that “disconfirmation is the stuff of science” (p. 548). Turner, Pratkanis, Probasco, and Level (1992) conducted experiments to test the groupthink model and “found little support for the strict interpretation of groupthink” (p. 795). Groupthink can be misinterpreted from an inappropriate group decision process. Some have included NASA management’s Challenger launch decision, made against the advice of engineers, as an example of groupthink, but Vaughan (1996) observed that “many of the elements of groupthink were missing, and those that were present have explanations that go beyond the assembled group” (p. 404). Bad decisions are all too common, but the building blocks and interactions shown previously in Figure 1 should be considered before declaring that a bad decision is explained by the theory of groupthink. Overall, Janis’ theory of groupthink over time continues to generate support and research.

Overview of Fire Station Environments

In the absence of an emergency alarm to direct skilled firefighter focus on more functional tasks, the idle fire station environment contributes to groupthink. Outpost fire stations are the community’s way to extend rapid response services closer to where the population lives and works. In the author’s home state of Alabama and applied to the largest 25 cities, a rough scale is that an outpost fire station is built for about every 10,000 population increase. This model applies more specifically to cities with a population of 100,000 or greater, where there is increased opportunity for more stations and less administrative oversight from above. It also may apply to cities from 50,000 to 100,000 population. Birmingham, with almost 300,000, has 30 outpost stations. In any event, as cities expand, more outpost fire stations are built to keep emergency services closely available to citizens.

The complexity of fire and rescue emergency mitigation requires complicated tools and team coordination. The stations provide a base for firefighters and equipment operating on a 24-hour basis. Although there are obvious differences in the details, the use of fire department teams is similar in every community throughout the United States.

Fire fighting teams in many cities work a shift of 24 continuous hours at a fire station, always in readiness for the next alarm. This is an important factor in understanding how fire stations serve as breeding grounds for groupthink. When not responding to an emergency or in training, team members eat together and sleep at the station. Each team at a fire station has a supervising officer. A group of stations, if the city is large enough, is usually supervised by a battalion chief, but fire station crews generally do not have direct outside supervision between alarms, and a fire fighting team may spend less than 5 percent of a shift in emergency response. From this consideration, it can be seen that outpost fire stations operate essentially as self-managed work teams, except when attacking a working fire involving multiple crews coordinated by a superior officer. Neck and Manz (1994) note that self-managed work teams "entail an increase in decision-making autonomy and behavioral control for work-team employees. The teams usually perform a relatively whole task and contain members who possess a variety of work skills" (p. 930). Neck and Manz add that self-managed work teams are highly susceptible to groupthink.

Although the officer in charge has clear authority and responsibility for the fire fighting crew, the socialization of the 24-hour shift often blurs and even eliminates the control boundary between officer and firefighters, especially in the relaxed hours between alarms. The stress of response to fires and other emergencies contributes to the bonding of the crew. During fire fighting, it is especially important that the crew work as a single unit. Group cohesiveness is desired, and it grows stronger with the passing years as the crew works together. Group cohesiveness also seems inevitable in this environment.

Examples of Fire Station Groupthink

After 343 members of the New York City Fire Department died in the collapse of the twin towers of the World Trade Center on September 11, 2001, firefighters across the United States were declared "America's Heroes." As fortunate tower employee survivors streamed out of the burning towers to safety that day, enduring and poignant images showed determined New York firefighters trudging in the opposite direction…up the stairs to help people still trapped on higher floors after terrorists slammed aircraft into both towers. Public gratitude and support for firefighters and fire departments, already strong nationally, became stronger.

Less than three years later, in August 2004, a woman alleged that she was raped by multiple firefighters in a New York City fire station in the Bronx. An official investigation concluded that at least three firefighters engaged in inappropriate sexual activity while on duty in the fire station and then tried to cover up their actions (Hearn, 2005). Two of them were accused of lying under oath to investigators. Their actions can be compared to the antecedents and symptoms of groupthink.

Sims (1992) examined unethical actions resulting from groupthink. When he saw a focus on individual culpability in news reports about unethical events in organizations, Sims said that "greater knowledge of the role of groupthink in unethical actions may change attributions of individual culpability" (p. 651). In group settings, perhaps the group influence needs more attention. By becoming more aware of group effects, we may be able, Sims said, to provide a basis for altering behavior in a more ethical direction. Where group cohesiveness is an important foundation of groupthink, Sims sees arrogance as a precipitator of unethical behavior: "Arrogance is the illegitimate child of confidence and pride found in groups experiencing groupthink" (1992, p. 658).

New York City is not the only place where potentially heroic teams of firefighters make unwise and destructive group decisions at fire stations. The fire department in Summit Township, Michigan, a small community located 80 miles from Detroit, dismissed seven male firefighters for having sex with women in two fire stations from 2000 through 2004 (Hagen, 2005). Other firefighters on duty during these activities were investigated for not reporting the policy violations. Although not all of the firefighters on duty were accused of having sex at the fire station, being aware of it does support the group connection to the behavior. Linda Willig, a former firefighter and currently a leadership consultant, was referring to the Summit Township cases when she said of firefighters, "They don't see their time on duty [evening hours at the fire station] as belonging to their employer. Some firefighters like to say that the fire station is their second home. Believing that can lead to some unfortunate expectations and outcomes" (2006).

Sexual activity is not the only event to demonstrate groupthink in the fire station. Alcohol has been recognized publicly as a problem at numerous fire stations across the United States. The *San Francisco Chronicle* reported in 2003 that "firefighters at some stations drink regularly during on-the-job 'cocktail hours,' and make life hard for colleagues who refuse to join in" (Van Derbeken, 2003). The article described how a firefighter who did not drink on duty was made to "keep a lookout," watching to make sure the supervising battalion chief did not arrive to surprise the rest of the on-duty crew drinking illegally during Sunday brunch. When the non-drinking firefighter assigned as lookout complained about the drinking, she was publicly labeled a "snitch" in the union newsletter, demonstrating both the pressures brought to bear on dissenters in the group and the concept of a "mindguard" acting to protect even inappropriate group norms.

The public controversy over alcohol use on duty at San Francisco fire stations did not inhibit firefighters elsewhere. Drinking at a Sacramento, Calif., fire station was combined with sexual activity in 2005, and at least 24 firefighters were disciplined (Jewett & Enkoji, 2005) when the events became public through newspaper accounts and city council discussions. Disciplinary actions were announced for the following: fire crews who took emergency fire trucks to bars while on duty, male and female firefighters having sex in the fire station, fire crews attending a "Porn Star Costume Ball" on duty and assaulting a woman there, and taking women on joyrides in fire department emergency vehicles. All of these activities involved groups of firefighters on duty at fire stations, not firefighters acting individually. One of the accused firefighters, who confessed but who obviously expected to escape accountability by his admission, was apparently still in the haze of Janis' illusions of morality and invulnerability when he said, "I did not, however, expect to be terminated after coming forward with the truth" (Jewett & Enkoji, 2005).

Another *Sacramento Bee* news report described two training captains "reportedly drinking beer on the job, and a supervising captain not reporting the incident to a battalion chief at a Fire Academy" (Hume, 2004). When a different captain did report the beer-drinking incident, writing "we must keep in mind the mission of our Recruit Academy Staff is to project a professional image, one that is not questionable by our actions, or questionable by our image" (Hume, 2004, n.p.), one of the involved captains made threatening remarks. After the reporting captain retired, he described other examples of groupthink in his fire department. Training offices are different from fire stations, but they share many of the potential conditions for groupthink.

Training academies are unfortunate locations for demonstrations of groupthink, because academies shape the attitudes of new firefighters. Technical experience with fire behavior (what works and what does not work safely), especially under the relatively controlled conditions of training, has been so well documented throughout the last 30 years that it seems highly unlikely that well-publicized past mistakes would be repeated numerous times. In reality firefighters continue to die in training fires (see below). The repeated explanation is that groups of experienced training officers fall into the defective decision-making of groupthink through group cohesiveness, insulation, illusions of invulnerability, illusions of morality, illusions of unanimity, collective rationalization, self-appointed mindguards, and direct pressure on dissenters. Examples are available for 1982, 1987, 2001, 2002 and 2004 (see below).

A cohesive group of training officers who had worked together for many years set up a live-fire training exercise in Boulder, Colorado (Demers, 1982), just as they had done several times in the past with the same hazards, apparently indulging in a continued illusion of invulnerability. Demers cited an overall lack of planning after numerous senior officers failed to properly evaluate the conditions of the training scenario. The so-called controlled fire rapidly grew out of control and killed two firefighters being trained.

Another cohesive group of training officers in 1987 set up a live-fire training exercise in Milford, Michigan, intending to provide realistic training simulation (Routley, 1988). The group training decision details illustrate an example of groupthink. Three firefighters died when a predictable flashover on the ground floor of a structure (acquired specifically as a setting for igniting training fires) trapped the firefighters on the second floor and blocked their exit. As with the Boulder, Colorado, training group, the Michigan trainers knew of the possibility of an explosive flashover but decided together to dismiss the risk.

Yet another cohesive group of training officers from several local mutual-aid fire departments in New York State set up a live-fire training exercise in 2001 (Tarley, Mezzanotte, & Koedam, 2002) similar to the Michigan exercise. Ignoring the risks and the history of previous tragedies, this training group's illusion of invulnerability and its faulty decision led to the death of a 19-year-old trainee and the conviction of a training officer for criminally negligent homicide. The judge in the case said, "This was not an accident. This was a series of bad decisions, decisions that should never, ever have been made" (Hassett, 2002). Any group dynamics leading up to the decisions were not acknowledged.

Additional similar tragic events resulting from defective decisions of cohesive groups of training officers demonstrating other traits of groupthink occurred three times in Florida (Florida Division of State Fire Marshal, FDSFM, 2003; FDSFM, 2004; & FDSFM, 2005); in Seattle (Castro, 2004); and in Memphis, Tennessee (Gardner, 2005; Drake, 2004). The repetition of such geographically diverse events and their repeated tragedies raise concerns that groupthink could be dangerously prevalent in fire departments.

Groupthink Prevention

Janis admitted that the challenge of preventing groupthink is complicated. He said that constructive thinking depends on like-minded people working together. The result is usually positive, but when groups work together extensively and develop too much cohesiveness, the quality of their analysis and decisions tends to go down. An extensive literature is oriented to groupthink prevention, especially in business leadership and policy-making settings where participants consciously want to make better group decisions. The fire service problem is that when poorly supervised firefighters are contemplating sexual activities or using alcohol at the fire station, they are off the path of analysis for better decision making.

Business solutions in the literature can seem hopelessly inappropriate for fire service use. For example, Gibson and Hodgetts (1986) provide business strategies for preventing groupthink, such as including advice to discuss the group's decisions with outside people to get feedback, or to invite outside experts directly into the discussion. Another of their tips is to hold a follow-up meeting after a decision is made, to air out any doubts of any group members. None of the Gibson and Hodgetts suggestions realistically address the special challenges of the fire station environment and actual fire service groupthink examples.

Janis is not much help, either, for the fire station environment. He offered nine prescriptions for preventing groupthink, but he also admitted that each has undesirable side effects. Forsyth (1999, pp. 332-334) grouped Janis' nine prescriptions into three techniques: (1) limiting premature seeking of concurrence, (2) correcting misperceptions and biases, and (3) using effective decision techniques. For fire administration consideration, these techniques remain more complicated when the participants are working 24-hour shifts away from direct higher authority and when weak or uninformed team supervision exists.

Prevention can be enhanced by better awareness of the symptoms of defective decision-making in groupthink. Janis listed seven symptoms of defective decision-making in groupthink (see Figure 1): (1) Incomplete survey of alternatives; (2) Incomplete survey of objectives; (3) Failure to examine risks of the preferred choice; (4) Failure to reappraise initially rejected alternatives; (5) Poor information search; (6) Selective bias in processing available information; and (7) Failure to work out contingency plans. These seven symptoms can be used by a group to consciously improve decision-making, but unless various prescriptions are used in conjunction with improvement of awareness about groupthink, firefighters engaging in groupthink will not recognize the approaching danger of groupthink.

Fire department administrators will have difficulty directly preventing groupthink in outpost fire stations due to the natural group cohesiveness of fire fighting crews, the insulating factors of the fire station life and 24-hour shifts, the cultural illusions of invulnerability and unanimity, and the forces that can be brought to bear on internal dissenters by mindguards. However, administrators can take action to reduce the tendency and complications of groupthink, although standard approaches consistently miss the mark with fire station conditions.

Defensive actions to prevent or reduce fire service-specific groupthink can be divided into three categories of response involving all personnel, but with clear support and direction from top fire department administrators: increased education, strategic scheduling and staffing, and more group-oriented discipline and accountability.

Education. Provide training in groupthink awareness for all department members at all levels to include basic knowledge and prevention of the antecedent conditions, symptoms of defective group decision making, and observable consequences to fire departments and individuals. Awareness is admittedly not the same as prevention, but it is a start, and changing an in-grown culture will take time. An outline of groupthink awareness training can be designed from the information in Figure 1, Theoretical Analysis of Groupthink. Initial training, even as brief as four hours, should be able to introduce the meaning and danger of groupthink, especially in cohesive teams living together for 24-hour shifts, and increase the ability of all members to recognize the conditions and impact of faulty group decisions called groupthink. Awareness sessions should demonstrate actual examples of group decisions that resulted in public scorn for fire departments from public disclosure of embarrassing group activities within fire stations.

Members with supervisory responsibility, especially company officers, should have additional specialized training to help them better manage the initial phases of strong group pressures for excessive conformity that can lead to groupthink. Many reports of outrageous fire station group activity that included apparent company officer knowledge of or participation in the activity generate a common question: “How could a company officer allow that to happen?” Company officer groupthink awareness training developed by fire department administrators should acknowledge the difficulty for company officers to maintain a balanced authority even during non-emergency station time. When relaxed station hours become too relaxed and the line between company officer and firefighters becomes too blurred, the company officer may also succumb to slow and subtle group pressures for conformity, even when leading to bad decisions. Recognition of the antecedent conditions and symptoms of groupthink are required foundations for supervisor awareness training.

For other firefighters operating from outpost fire stations, awareness training should include an emphasis on the dangers of excessive conformity and provide ways to express dissent early in a group decision process that seems to be trending toward potential group embarrassment. This would represent a cultural change in most fire stations, but if potential dissenters are not empowered with better group skills, the whole group will suffer from the bad decisions that become public. Fire station crews with a potential for groupthink would be better served if dissenters were rewarded rather than ostracized or further punished. More skillful dissention can become possible when the awareness training provides firefighters with better critical thinking skills, small group communication skills, and conflict-management skills. This would be designed to empower group members to be more critical evaluators of group decisions at fire stations.

A battalion chief is usually responsible for several fire stations and supervises whatever emergencies require response from those stations, but battalion chiefs may leave non-emergency fire station operations to individual station captains. The problem is that this leaves the potential for groupthink within a fire station unchecked during the many hours of non-emergency operation, especially in the evening hours. Battalion chiefs with extensive emergency response experience should be trained to be more of a supervisory presence at individual fire stations. Unscheduled visits at different hours of the day and night will help prevent the atmosphere where groupthink tendencies are allowed to fester and cause trouble for the fire department.

Strategic scheduling and staffing: The single strongest solution for limiting fire station groupthink may be to eliminate 24-hour-long shifts. An alternate combination of shorter shifts can reduce the accumulation of idle hours per shift compared to any fire crew operating longer 24-hour shifts. Unfortunately, day/night shift combinations introduce increased staffing expense and would be resisted in many municipalities where groupthink problems have not yet erupted into public embarrassment.

In any shift schedule setting, fire department administrators should not allow fire station operations to be so independent as to be able to cover up internal misdeeds. Although fire stations, especially in larger cities, are indeed outposts, they need to be operated so that personnel do not feel disconnected from higher authority. Policies should be used to reduce the group pressures toward conformity more prevalent in outpost stations.

Hiring for diversity is a potential tool of strategic staffing. By its nature, diversity counters a tendency to think exactly alike. Unfortunately, this solution also has its limits. Even diverse members of a fire fighting team often become socialized to yield personal preferences to group preferences. Diverse group members remain subject to the pressures of ostracism if they carry opposition to apparent group preferences too far.

Strategic staffing can include periodically rotating personnel to different station environments to prevent groupthink practices from becoming deeply embedded. Moving company officers to different stations, in conjunction with awareness training, makes them less subject to the group pressures that build up over time and work to compromise the company officer's authority through the socialization of a 24-hour shift. Fire fighting teams still need to be made up of cohesive groups, but standardized department training is already designed to make team members interchangeable throughout the department to fill in anywhere when needed. This standardized training should allow any company officer or other team member to be transferred to another station without significantly altering any team's effectiveness during emergency response. ***The most important single step to prevent groupthink is to keep company officers from feeling the pressures of excessive group conformity in matters not related to actual fire fighting.***

The argument against rotating company officers is that they have learned details about a current territory and this experience can enhance emergency response. This is true so long as group cohesiveness between alarms is not allowed to compromise reasonable expectations of supervision. In too many groupthink situations that become embarrassing to the entire fire department, it can be seen that subtle group pressures resulted in the company officer failing to provide basic supervision at the fire station. The advantages of company officer rotation outweigh the disadvantages. Preserve the effectiveness of cohesive fire fighting crews, but rotate all fire crew officers regularly so that they work with different crews and the crews experience a variety of management styles.

Discipline through supervisor and group accountability. Fire department administrators must rethink the philosophy of discipline seen in many public embarrassments resulting from groupthink actions. When an individual is caught violating rules from an incident involving group action or group knowledge, the tendency is to publicly punish the individual who was caught. Then a wall of silence can descend to hide actual group involvement or knowledge and cover-up. An improved discipline philosophy includes an understanding that many incidents that harm public support for fire departments are group actions, even if only one individual is caught. The discipline philosophy of department administrators should analyze group contributions to the event. There have been cases when a firefighter was caught having sex in the fire station. In such situations, the rest of the crew may have knowledge but acquiesced in a cover-up. If an individual firefighter violates a rule, hold the company officer more accountable, along with the individual. If the rest of the station crew knew about a transgression but failed to act to prevent harm, hold the rest of the station crew accountable.

Administrators should make sure that they provide support for any department member reporting a rules violation. Otherwise the internal pressure of a fire station group will successfully eliminate dissent and reporting of violations until group decision problems expand and burst out into public awareness.

Conclusion

Although not all examples of poor judgment in fire station environments are products of groupthink, fire stations do provide a breeding ground for the concurrence-seeking culture found in fire fighting crews anywhere in the United States. The evidence is that fire administrators tend to avoid these problems until they become public. But group decision problems, in the same way as fires, are better handled when they are small.

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The Non-Invasive Carboxyhemoglobin Monitoring of Firefighters Engaged in Fire Suppression and Overhaul Operations

Abstract

The purpose of this prospective, single group repeated measures sample design study was to determine the real time carboxyhemoglobin (COHgb) levels of firefighters with and without the use of self contained breathing apparatus (SCBA) as they were engaged in various fire suppression duties in live fire training exercises. Data was collected using a finger probe non-invasive CO-oximeter device included carboxyhemoglobin levels at baseline, on SCBA during fire suppression activities and off of SCBA during overhaul operations. The COHgb level of firefighters off SCBA during overhaul operations were significantly higher when compared to the baseline or on SCBA during fire suppression COHgb values, ($p<0.0001$) for both comparisons. In the setting of overhaul operations, firefighters who were working without the protection of SCBA developed elevated, and potentially harmful, levels of COHgb.

Introduction

Fire fighting has always been and remains an inherently dangerous vocation resulting in thousands of injuries and approximately 100 firefighter deaths each year in the United States (NFPA®, 2006; National Fire Administration, 2006). Approximately one quarter of these deaths occur on the fireground. It has become increasingly evident that firefighters are at risk for both acute and chronic exposure to chemical asphyxiants produced by the combustion of building materials, including carbon monoxide gas.

The purpose of this study was to assess the carboxyhemoglobin levels of firefighters via non-invasive SpCO determinations in real time as they were engaged in various fire suppression duties as simulated in live fire training sessions.

Methods and Materials

The project was approved by the Institutional Review Board of the University of Pennsylvania. Fire department members signed informed consents agreeing to participate in the study.

The study design was a prospective, single group repeated measures sample of career and volunteer firefighters from the Malvern Fire Company (PA) engaged in a prescheduled live fire training exercise designed to approximate smoke and heat conditions encountered in structural fire fighting.

Data were collected at a municipal training facility where fires were set within a concrete fire training tower. The materials set on fire for purposes of heat and smoke generation within the tower were dry hay bales and discarded wooden loading pallets. Standard highway road flares were used to ignite the materials. No hydrocarbon-based accelerants were used to ignite or intensify the burning of the wood and straw.

The training was part of the routine fire department training schedule and was supervised by fire department officers. The investigators did not manipulate any of the training conditions nor dictate the duties the firefighters were instructed to perform. During the training evolutions and cleanup of the training tower, firefighters donned and doffed self-contained breathing apparatus (SCBA) as per departmental training and operational policies.

Firefighter carboxyhemoglobin concentration was determined using an FDA approved noninvasive, finger probe CO-oximeter device (Rainbow SET CO-Oximeter, Masimo Corporation, Irvine, CA). The device uses the same design principles as a standard pulse oximeter including a sensor that is designed to be placed on the finger of a patient. The device utilizes multiple wavelengths of light and noninvasive spectrophotometric principles to be able to determine the SpO2, pulse rate, and the COHgb concentration. The resultant new parameter is referred to as the "$SpCO_2$ because it is obtained from a multi-wavelength noninvasive pulse oximeter. The device provided whole number carboxyhemoglobin levels with a minimum reading of one percent. In the manufacturer's clinical trials of 452 samples, the SpCO determined by the device was found to be accurate within +/- 3% of the simultaneously obtained venous COHgb levels (Masimo, 2006).

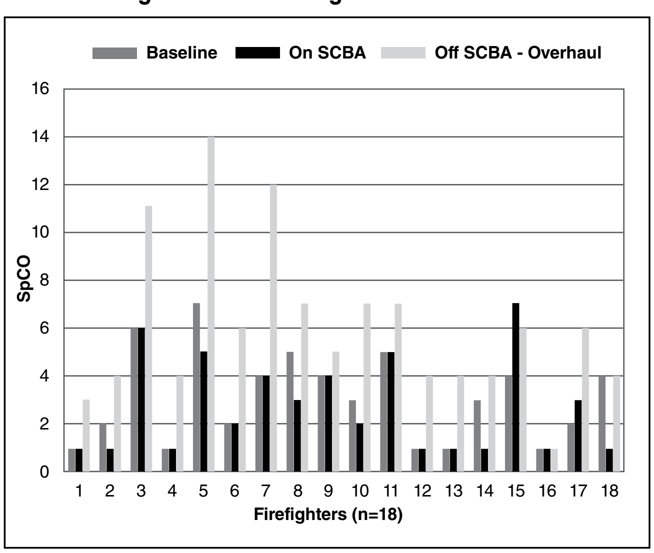
Baseline SpCO determinations were made outside of the training tower just prior to the firefighters donning self-contained breathing apparatus (SCBA) and before entering the training building. SCBA allowed the firefighters to breathe un-enriched air. Firefighters then entered the fire training building and conducted search and rescue and fire suppression duties in heavy smoke and intense heat conditions for approximately 15 to 20 minutes. Immediately after exiting the training tower the firefighters doffed their SCBA masks and a second SpCO reading was obtained.

After all crews had completed their rotations through the tower, the fires were extinguished and the tower was partially ventilated by opening the steel windows and doors of the structure. At this juncture the firefighters re-entered the tower without their SCBA units to clean up the smoldering remains of the hay and wooden pallets as per normal procedures for training tower use. This phase of fire fighting operations is termed "overhaul." At the completion of this overhaul phase of training tower operations a third and final SpCO determination was obtained. Statistical analysis of firefighter SpCO data was accomplished utilizing analysis of variance in repeated measures.

Results

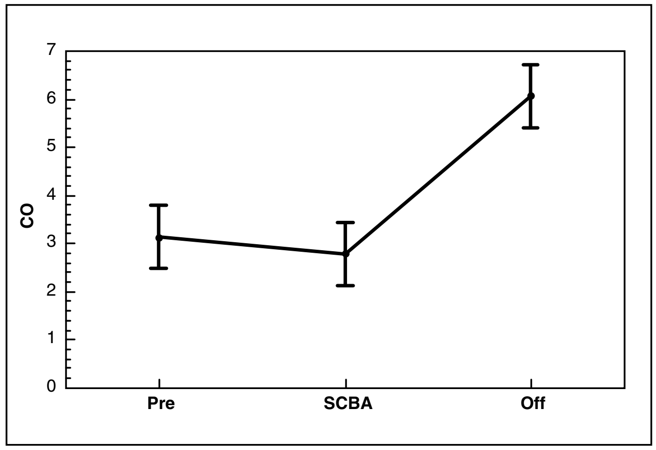
Three full sets of SpCO data were collected on eighteen firefighters ranging in age from 18 to 51 with a mean age of 25.3 years. The SpCO levels of firefighters off SCBA during overhaul operations (mean SpCO 6.1% +/-3.3) were significantly higher when compared to the baseline levels (mean SpCO 3.1% +/-1.9) or the levels on SCBA during fire suppression (mean SpCO 2.8% +/-2.0), ($p<0.0001$) for both comparisons. The individual COHgb levels of the firefighters at baseline, on SCBA during fire suppression and off SCBA during overhaul operations are shown in Table 1. Baseline SpCO readings ranged from 1 to 7%. Firefighter COHgb levels through the three determination readings are summarized in Figure 1.

Table 1: COHgb Levels in Firefighters



There was no significant change in COHgb levels during fire suppression operations while wearing SCBA as compared to baseline data. However, firefighter COHgb levels increased significantly during overhaul operations while not wearing SCBA as compared to both their baseline levels and the levels encountered during fire suppression operations while wearing their SCBA. The COHgb levels of firefighters off SCBA during overhaul operations were significantly higher when compared to the baseline or on SCBA values, ($p < 0.0001$ for both comparisons).

Figure 1: Carboxyhemoglobin Levels of Firefighters



Discussion

The step-by-step approach to structural fire fighting taken by firefighters is relatively standardized (Smith, 2002). The first phase involves gaining entry and access to the fire. In this phase the structure may also be ventilated to clear superheated gases to facilitate safer access to the fire. The next step is physical fire suppression when water is used to extinguish or "knock-down" the fire. The final phase of operations is the overhaul phase where any remaining smoldering materials are exposed and extinguished.

Our study was unique in the literature as it tracked sequential COHgb levels in firefighters throughout a live fire situation that included baseline readings, readings during fire suppression breathing air from SCBA, and during overhaul operations off SCBA.

Although not identical to actual structural fire fighting operations, live fire training in concrete fire training towers is a reasonable approximation of heat and smoke encountered by firefighters. Firefighters engaged in live fire training tower operations undergo significant physiologic stress similar to that incurred during actual fire fighting (Smith et al., 1996; Smith et al., 1997).

In the United States, self-contained breathing apparatus (SCBA) is routinely worn by firefighters during ventilation and fire suppression operations (IFSTA, 1998). SCBA allows firefighters to breathe air directly from an air cylinder and regulator system that also provides positive pressure in the firefighter's mask. Positive-pressure SCBA masks profoundly reduce the risk of inhalation of smoke and other products of combustion including carbon monoxide (Burgess & Crutchfield, 1995; NIOSH, 1987). Although typically worn during ventilation and fire suppression, there is greater inconsistency among fire department policies as to whether SCBA is to be worn during overhaul operations (Burgess, 2001). At the time of this study, the Malvern Fire Company did not require its firefighters to wear SCBA during overhaul operations.

Carbon monoxide is a byproduct of the partial combustion of many materials including wood and silk and is ubiquitous in the environments encountered by firefighters during structural fire fighting (Goldfrank et al., 2002). Our study demonstrates that firefighters are well protected from CO exposure during fire suppression activities while wearing SCBA. Indeed, anecdotally, firefighters with mildly elevated baseline COHgb levels tended to have reduced COHgb levels after being on SCBA air during fire suppression evolutions. However, firefighters did develop significant increased levels of COHgb while conducting overhaul operations after the fires were knocked down when they were not wearing protective SCBA.

The reality that increased environmental levels of CO still exist after the fire has been generally extinguished during actual fireground and training tower overhaul operations has been well documented by previous researchers (Burgess, 2001; Barnard et al., 1979; Cone et al., 2005).

Although none of the firefighters in this study developed elevations in COHgb levels that would be considered immediately life threatening, the potential deleterious effects on the cardiovascular, pulmonary, and neurologic systems of acute and chronic “low level” exposure to CO are certainly problematic.

Repetitive exposure to CO among firefighters has long been postulated as contributing to the historically higher incidence of coronary artery disease among firefighters that has been observed since the 1950s (Barnard, 1979). This older literature should be interpreted in light of the fact that United States firefighters of the 1950s and 1960s did not routinely wear or even have access to SCBA.

Burgess correlated significant acute derangements in the pulmonary function parameters of firefighters working in the overhaul environment who were not wearing positive pressure SCBA to their elevated serum carboxyhemoglobin levels (Burgess, 2001). These changes included increased alveolar capillary membrane permeability and decreased FEV1.

More recent cardiovascular related studies have clearly demonstrated the risks of what have been traditionally considered low levels of COHgb. Exposure to CO at concentrations sufficient to achieve just 2.5 to 3.5% COHgb can precipitate angina and electrocardiographic evidence of myocardial ischemia in patients with preexisting coronary artery disease (Allred et al., 1989; Allred et al., 1991). These levels are insufficient to cause tissue hypoxia, but low-level CO exposures can cause intravascular neutrophil degranulation with deposition of myeloperoxidase along vascular walls (Thom et al., 2006). Similar changes in intravascular myeloperoxidase are linked to a heightened risk for acute coronary syndromes (Biasucci et al., 1996; Furman et al., 1998; Ott et al., 1996).

Neurological impairments from chronic or recurring and intermittent CO exposures have been reported inconsistently in clinical investigations (Amitai et al., 1998; Ely et al., 1995; Lindgren 1960).

Our study combined with the work of previous investigators clearly demonstrates the need for uniform use of SCBA in all phases of structural fire fighting. Subsequent to this study’s data being presented to the command officers of the Malvern Fire Company, a policy was instituted requiring firefighters to wear their SCBA during all phases of interior fire fighting operations, including overhaul.

Conclusions

Carbon monoxide possesses a risk to firefighters’ health and safety. Firefighters are well protected from developing elevated carboxyhemoglobin levels while wearing SCBA during fire suppression activities. However, in the setting of overhaul-like operations, firefighters who were working without the protection of SCBA developed elevated and potentially harmful levels of COHgb. Standards that mandate the use of SCBA during all portions of interior structural fire fighting, including overhaul operations, should be uniformly adopted by all fire departments. The development of such standards is clearly a management and leadership issue within the fire service. Finally, it is the authors’ hope that our research could help support an educational initiative in the fire service to educate firefighters not only about the risks of acute CO poisoning, but also risks of long-term low-level CO exposures, which are significant and also pose a true risk to firefighter health and safety.

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Firefighter Health: A Pilot Study of Firefighter Health Surveillance

Abstract

Recent research on health and wellness has suggested that firefighters are at increased risk for health concerns (e.g., cancer, heart disease). Limited information is available about the prevalence and role of modifiable risk factors such as health behaviors related to tobacco use, physical activity, and nutrition in this population. The current study reports findings of a cross-sectional survey of firefighters that investigated issues such as health status, health practices related to substance use, and lifestyle factors.

Introduction & Literature Review

The firefighter's role in the broad emergency response network of the United States includes more than just fire alarms; they are charged as first responders to a wide range of emergency and disaster calls. This unique set of responsibilities places on the firefighter a high burden of stress and other work-related health hazards. According to a report by the Centers for Disease Control and Prevention (2006), on-duty fatalities for firefighters in the United States numbered 948 between 1994 and 2004. Considering the dangers firefighters routinely face, this number is a testament to the training and protocol in place to prevent such casualties. However, what is the most surprising are the causes behind the number of fatalities. Of the 948 fatalities reported, nearly half were cardiac-related events. Of these deaths, 97 percent of career and 98 percent of volunteer firefighter cardiac deaths were attributed to stress or overexertion.

Findings related to the relative risk of cardiac deaths in the fire service have been somewhat mixed. Upon examining death certificates, Calvert, Merling and Burnett (1999) reported that firefighters have among the highest proportionate mortality ratio for ischemic heart disease. Several studies conducted in the 1980s and 1990s also reported positive and significant relationships between cardiovascular disease and fire fighting (e.g., Aronson, Tomlinson, & Smith, 1994; Bates, 1987; Feuer & Rosenman, 1986; Grimes, Hirsch, & Borgeson, 1991; Sardinas, Miller, & Hansen, 1986). However, other studies conducted at this time reported non-significant relationships (e.g., Burnett, Halpern, Lalich, & Sestito, 1994; Deschamps, Mosmas, & Festy, 1995; Eliopulos, Armstrong, Spickett, & Heyworth, 1984; Guidotti, 1993). The reasons behind the discrepancy are unclear. However, one hypothesis is that the discrepancy may be attributable to what has been termed the "healthy worker effect" (Choi, 2000). The selection process for new firefighters favors those who have above-average stamina and strength, making a comparison to standard population control groups prone to error. In fact, passing a strenuous physical test is required prior to admission into many fire training academies. Therefore, Choi (2000) explains, the expected risk of cardiovascular disease, given the relative health of firefighters at selection and hiring, should actually be lower than the general population. He reassessed the literature available at the time and found that several of the studies actually produced significant and positive results when adjusted for the "healthy worker effect" even when they initially presented non-significant differences in risk (e.g., Burnett et al., 1994; Deschamps, Mosmas, & Festy, 1995; Eliopulos et al., 1984).

The very nature of fire fighting likely lends itself to increased cardiovascular risk. To explain the increased prevalence of cardiovascular disease found, researchers have hypothesized a number of contributing factors. Barnard and Duncan (1975) studied firefighter's cardiovascular response to an alarm call. In their study of 35 firefighters responding to 189 alarms, an average increase of 47 beats per minute was observed (range 12-117 beats per minute increase) after hearing the alarm and high levels of arousal also were maintained after the initial alarm. Increased levels of psychological and physical arousal have been related to increased incidence of cardiovascular problems (Rozanski, Blumenthal, & Kaplan, 1999). Encounters with carbon monoxide may be another contributing factor. The National Fire Protection Agency recommends use of the self-contained breathing apparatus (SCBA) for all firefighters (NFPA®, 2002). Barnard and Weber (1979) found that dangerous levels of carbon monoxide remain at alarm sites even after visible smoke and fumes cleared, when firefighters were less likely to use such protection. Another factor may be the night and day shift schedules required of firefighters. Knutsson et al. (1986) found that shift work was correlated to ischemic heart disease, even when smoking status and age were considered.

Risk factors such as elevated levels of arousal and shift work schedules are not easily modifiable. However, a number of modifiable cardiovascular risk factors have been identified among fire service personnel. In one study of the Omaha Fire Department, Chief Mancuso (2003) found that 73 percent (N = 647) of fire service professionals in his fire department were either overweight or obese. In another instance, the National Volunteer Fire Council (NVFC, 2005) provided free health screenings at local and regional fire conferences. Of the screenings conducted, the average body mass index (BMI) scores were in the overweight category ranging from 27.4 to 29.8. An average of the four screenings performed found that only 28.5 percent (N = 3089) of participants were in the normal range (i.e. BMI 18.5-24.9). The survey methodology used in obtaining this data (participant self selection, possibility of family member inclusion) limits conclusions that may be drawn, but indicates strongly the need for more in-depth and controlled studies.

The trend of increasing BMIs among the nation's firefighters may be related to the "firehouse culture," a natural consequence of the stressful situations, shift work, and downtime firefighters endure. Food plays a central role in the routine of those on duty, with the majority of crewmembers participating in meals. A firefighter interviewed in an article by Osborn (2005) states "The whole culture of the firehouse is based on food. One of the challenges between fire calls is, you get bored, and you want to eat, so you float to the refrigerator." In the same article, Osborn stated that the choice of one department to eat vegetarian meals in an attempt to reduce cholesterol was uncommon and "their choice still sends comrades at other fire stations into gales of laughter." In these situations, making individual choices for healthier eating is clearly difficult when a meal is shared among so many. Additionally, while many departments suggest physical activity as a part of daily duty activity, anecdotal evidence from firefighters indicates that structured physical activity often is not a priority. The combination of negative health choices and job-related risk factors makes management of modifiable risk factors even more imperative for firefighters. While efforts are being made and resources are being expended in the effort to decrease the rate of cardiovascular deaths in the fire service, the rate of line of duty deaths attributable to cardiovascular complications remains relatively constant (CDC, 2006).

Recent evidence demonstrates the importance of targeting firefighters in education and prevention efforts. Kales, et al. (2007) found that firefighters responding to an emergency were between 10 and 100 times more likely to die from coronary heart disease during emergency activities when compared to nonemergency duties. The awareness level of leadership toward the importance of improving cardiovascular risk factors in firefighters has been increased and new prevention programs initiated (United States Fire Administration, 2005; NVFC, 2005), but the rate of line of duty deaths attributable to cardiovascular complications remains relatively constant (CDC, 2006). In order to adequately assess the obstacles, knowledge, attitudes, and practices of firefighters relating to cardiovascular health, a more comprehensive study is needed.

To date, information about the health of firefighters has been inconsistent. Programs such as the screenings by the NVFC and reports at the department level provide some insight into the plight of health status in the fire service; however, the findings are limited because the samples may be biased and not necessarily representative of the entire fire service. Currently, no regional or national standardized health surveillance system for firefighters exists. In order to accurately assess the risks to firefighter health, it is important to develop a comprehensive and consistent understanding of the current state of health for this population. This surveillance would in turn be used to understand risk profiles, particularly to understand who is most at risk, in order to target intervention and prevention efforts. Ultimately, a longitudinal assessment will be integral in comparing risk factors across time and gauging the changing health of the fire service as interventions are implemented. Without such an assessment, it is not possible to accurately gauge the impact of efforts to change firefighter health.

By developing a surveillance measure and obtaining preliminary information in select departments, the obstacles, knowledge, attitudes and practices most important to cardiovascular health can be identified and targeted in a larger, more comprehensive study. The purpose of the current survey was to pilot a data collection of the type of health surveillance measure proposed for the fire service.

Methods

Two Midwest fire departments participated in data collection. Surveys were distributed to every member of the department. Firefighters were provided with a gift card as appreciation for considering participation. Upon completing the survey, participants sealed them in an envelope and returned them to the designated department contact. The overall response rate was 72 percent (N = 132). The project received approval from the Institutional Review Board at the Kansas City University of Medicine & Biosciences.

Instrumentation

The survey for the current project was developed based on previously published surveys.

Overall Physical Health: BMI was calculated by using self-reported height and weight. BMI is calculated as kilograms divided by height in meters squared.

Participants were categorized as underweight (<18.5kg/m^2), healthy weight (range, 18.5–24.9 kg/m^2), overweight (range, 25.0–29.9 kg/m^2), or obese (>30.0 kg/m^2), in accordance with the World Health Organization (2003) guidelines. A single item question: "Would you say your overall physical health is" with response options of poor, fair, good, very good or excellent was used to measure overall self-rated health. This type of question is one of the most widely used measures of health status (Krause & Jay, 1994). For questions about medical co-morbidities, participants were presented with a list of common health concerns and asked, "Have you ever been told by a doctor, nurse or other health professional you have, or are you currently taking medications for each of the following conditions" with response options of "yes," "no," or "I don't know."

The Self-Report of Physical Activity (SRPA) Questionnaire: The SRPA questionnaire provides a global self-rating of physical activity patterns. Indicators of the questionnaire's validity in adult populations (significant correlation between SRPA ratings and measured maximal oxygen consumption) have been published elsewhere (Jackson et al., 1990). For this study, students were instructed to select a value from the questionnaire that best described their physical activity pattern during the past 30 days (Jackson & Ross, 1997). Values ranged from zero (no regular physical activity) to seven (regular, heavy physical activity such as running over 10 miles per week). Students were categorized as either sedentary (0 and 1 - no regular physical activity) or active (2 through 7 - regular participation in moderate or heavy physical activity). The headings "sedentary" and "active" will be used to denote categorization based on the physical activity questionnaire.

Stage of Change for Exercise: A single question was used to assess each student's current stage of change for exercise behavior. Students were required to select one of five statements, placed ordinally on a conceptual ladder (Wyse et al., 1995) describing their current exercise behavior and intentions concerning exercise initiation within the next six months. The statements were previously developed for exercise behavior (Marcus, Selby, Niaura, & Rossi, 1992) and have been termed and defined as follows:

- Precontemplation - I presently do not exercise and do not plan to start exercising in the next 6 months.
- Contemplation - I presently do not exercise, but I have been thinking about starting to exercise within the next 6 months.
- Preparation - I presently get some exercise, but not regularly.
- Action - I presently exercise on a regular basis, but I have only begun doing so within the past 6 months.
- Maintenance - I presently exercise on a regular basis and have been doing so for longer than 6 months.

In the heading of the question, regular exercise was defined as three or more days per week for 20 minutes or more each day of activities such as walking, jogging, swimming, and aerobics.

Additional Physical Activity Questions: Participants were also asked to provide information on the number of days during the past week they engaged in moderate and vigorous physical activity and how much time per week they spend sitting and watching television. These questions were taken directly from the International Physical Activity Questionnaire (IPAQ), which has been shown to be a reliable (Spearman's p = 0.8) and valid (Spearman's p = 0.33) instrument for obtaining detailed assessments of physical activity in 18-65 year old men and women (Booth, 2000; Craig et al., 2003).

Subjects were classified as meeting vigorous physical activity guidelines if they engaged in at least 10 minutes of vigorous physical activity on three or more days during the past week. They were classified as meeting moderate physical activity guidelines if they engaged in at least 10 minutes of moderate physical activity on five or more days during the past week (Pate et al., 1995).

Estimated maximal oxygen consumption ($V0_2max$): A non-exercise model was used to estimate VO_2max. The subjects' age, gender, body mass index (BMI), and SRPA (physical activity level) were entered into a regression equation to estimate VO_2max. This method is as accurate as methods using sub-maximal exercise heart rate to estimate aerobic capacity (Jackson et al., 1995). VO_2 max as the maximum capacity to transport and utilize oxygen during exercise. It is also known as aerobic capacity, which reflects the physical fitness of a person (Astrand & Rodahl, 1986).

Weight management: Questions about weight management were taken from the CDC's (2002) Behavioral Risk Factor Surveillance System survey questionnaire. Questions about weight practices included: "Are you trying to lose weight?" "Are you eating fewer calories or less fat to lose weight?" "Are you using physical activity or exercise to lose weight?"

Tobacco Use: Questions about tobacco consumption included: "Have you smoked at least 100 cigarettes or the equivalent amount of tobacco in your lifetime?", "Do you now smoke daily, occasionally or not at all?" (CDC, 2002). Smokeless tobacco use was assessed with the following questions: "Have you ever used chewing tobacco, snuff or dip?" "During the past 30 days, on how many days did you use chewing tobacco, snuff or dip?" (Bray et al., 2003).

Alcohol Use: Participants were asked about the number of days in the past month they had drank alcohol. Next, they were asked how many drinks they drank on average at each instance of drinking. To assess the frequency of binge drinking, participants were asked "Considering all types of alcoholic beverages, how many times during the past 30 days did you have 5 or more drinks on one occasion?" Finally, they were asked how many times during the past 30 days they had "driven when you've had perhaps too much to drink."

Firefighter Health Beliefs: A list of firefighter health beliefs was developed for the current survey. Perceptions focused on perceived risk for firefighters of cancer, heart disease and early mortality. Questions also focused on perceptions of prevalence of cigarette and smokeless tobacco use among firefighters. Firefighters were asked about their perceptions of department priorities related to physical fitness and nutrition with the items: "My fire department makes physical fitness a priority." "My fire department makes nutrition a priority." They also were asked to what degree they agreed or disagreed with the statements, "The leaders of my department put an emphasis on health and wellness" and "My on-duty health habits are better than my off-duty health habits" using a 5-point Likert scale.

Participants

The sample was primarily firefighters (66.1%; N = 132) but also included a sampling of lieutenants/captains (22.0%) and chief staff (11.8%) and nearly all career (96.2%), with a few volunteer firefighters. More than half (64.6%) of the participants had an associates, bachelors, or advanced degree. The sample was 95.4 percent male and primarily (97.6%) white. The average age of participants was 37.9 years old (SD = 8.9).

Results

Physical Health

Overall Physical Health. On average, the firefighters had a body mass index (BMI) of 27.65 (SD = 4.06, range 19 to 42.72). Of those surveyed, 27.6 percent were in the normal range, 47.2 percent were in the overweight range, and 25.2 percent were in the obese range (N = 127; see Table 1). The prevalence rate of self-reported co-morbidities of other health concerns was 12.6 percent for high blood pressure and 23.4 percent for elevated cholesterol. When asked, "Would you say your overall physical health is Poor, Fair, Good, Very Good or Excellent?" only 3.9 percent reported being in poor or fair health.

Physical Activity. According to responses on the IPAQ, participants engaged in vigorous physical activity an average of 3.3 (SD = 1.6) days per week. Participants reported engaging in moderate physical activity an average of 3.7 (SD=2.0) days per week. The participants reported watching 11.4 hours of TV per week (1.6 hours/day) and spending 29.8 hours/week sitting (4.3 hours/day). Most of the participants were in the action and maintenance stages of change (48.5% action and 13.8% maintenance) and only 3.1 percent were in the pre-contemplation (n= 1) and contemplation (n = 4) stages or change. The average estimated VO_2max was 41.0 ml.kg-1.min-1, which is slightly less than the average for young, untrained males (45.0 .ml.kg-1.min-1).

Table 1: Overall physical health of firefighters (n = 132)

	Percent
Body Mass Index	
Underweight (BMI < 18.5kg/m^2)	0.0
Normal Weight (BMI range 18.3-24.9 kg/m^2)	27.6
Overweight (BMI range 25.0-29.9 kg/m^2)	47.2
Obese (BMI > 30.0 kg/m^2)	25.2
Self-Rated Physical Health	
Poor	0.8
Fair	3.1
Good	41.5
Very Good	44.6
Excellent	10.0
Co-Morbidities (% responding "yes")	
Type I diabetes	2.3
Type II diabetes	0.1
High blood pressure	12.6
High Cholesterol	23.3
Arthritis	11.6
Asthma	10.4
Heart disease	1.6
Cancer	0.1

The lowest VO_2max was 10.8 ml.kg-1.min-1, with the highest being 53.6 ml.kg-1.min-1. Slightly over 18 percent of the subjects had a VO_2max under 35 ml.kg-1.min-1, a level below which risk of all-cause mortality significantly increases (Blair et al., 1989).

Weight Management. Of those surveyed, 56.2 percent reported that they were trying to lose weight. Nearly half (48.4%) reported eating fewer calories or less fat to lose weight and more than half (57.3%) reported using physical activity or exercise to lose weight.

Health Behaviors

Only 11.1 percent of the sample reported using cigarettes daily or occasionally and had smoked at least 100 cigarettes in their lifetime. A small group (4.8%) reported being experimental smokers who smoked occasionally but had not smoked at least 100 cigarettes in their lifetime. Of the sample, 22.0 percent reported using chewing tobacco, snuff or dip in the last 30 days. With regard to alcohol, 83.3 percent reported consumption in the past 30 days. Of those who reported drinking one or more times in the last month, they drank an average of 10.0 days of the month (SD = 6.8 days). During periods of alcohol consumption, participants drank, on average, 3.1 drinks (SD = 2.3 drinks) each day. They reported drinking five or more drinks at a single occasion two times (SD = 4.1 times) during the past month. Of those who reported drinking alcohol in the past month, 14.5 percent reported driving when they had perhaps had "too much" to drink.

Beliefs about the Fire Service and Health

When asked about their beliefs concerning firefighter health, 58.3 percent reported that firefighters die earlier than the average person in the United States (see Table 2). With regard to heart disease, 56.8 percent reported believing that firefighters have higher rates of heart disease than the average person in the United States. About 48 percent believed that firefighters have a higher rate of cancer than the average person in the

Table 2: Health beliefs about the fire service (n = 132)

	% Responding "True"
Do firefighters die earlier than the average person in the United States?	58.8%
Do firefighters have higher rates of heart disease than the average person in the United States?	57.3%
Do firefighters have higher rates of cancer than the average person in the United States?	50.0%
My fire department makes physical fitness a priority	
Strongly disagree	2.3
Disagree	8.5
Neutral	13.0
Agree	46.2
Strongly agree	30.0
My fire department makes good nutrition a priority	
Strongly disagree	7.8
Disagree	23.4
Neutral	36.7
Agree	25.8
Strongly agree	6.3
The leaders of my department put an emphasis on health and wellness	
Strongly disagree	3.1
Disagree	3.1
Neutral	20.0
Agree	51.5
Strongly agree	22.3
My on-duty health habits are better than my off duty health habits	
Strongly disagree	6.9
Disagree	32.3
Neutral	26.9
Agree	30.8
Strongly agree	3.1

United States. On average, firefighters believed that 32.1 percent (SD = 16.4, range 2-85) of firefighters smoke and 31.25 percent (SD = 17.9, range 5-90) of firefighters use chewing tobacco.

The departments surveyed reportedly placed emphasis on physical fitness. When asked whether their department makes physical fitness a priority, 76.2 percent agreed or strongly agreed that it did. Less emphasis was put on proper nutrition in that only 32.1 percent agreed or strongly agreed that their department makes good nutrition a priority. Overall, 73.8 percent agreed or strongly agreed that the leaders of their department put an emphasis on health and wellness. Only about a third (33.9%) of firefighters sampled reported agreeing or strongly agreeing that their on-duty health habits were better than their off-duty health habits.

Discussion

Of those surveyed, 72.4 percent were in the overweight or obese range, which is higher than the national average but consistent with other findings among firefighters (e.g., Mancuso, 2003). However, given their high rate of physical activity, it is possible that BMI is not a valid measure of weight status in this population. Criticism over BMI has been expressed because the numerator (weight) does not discriminate between muscle, fat, bone, or vital organ tissue. An individual with high fat-free mass relative to stature (e.g., physically active person) might have a high BMI but not be overweight (Wellens et al., 1996). On the other hand, more than half of the firefighters said they wanted to lose weight and many studies have demonstrated that respondents tend to overreport their physical activity levels when compared with objective measures (Sallis & Saelens, 2000). More attention needs to be paid to weight in the fire service, how to measure diet and exercise, and how to gauge weight most effectively with this population.

Rates of tobacco use in the current sample were relatively low while rates of alcohol consumption were relatively high. Several reported frequent use of alcohol and frequent binge drinking (5 or more drinks consumed at a single occasion). While rates of reported cigarette and smokeless tobacco consumption were relatively low, perceptions of the rates of firefighter tobacco use were relatively high. It will be important to examine whether this particular sample was less likely than their peers to be tobacco users and whether the perception of tobacco in the fire service is inaccurate.

It is interesting to note that nearly two thirds of participants reported a belief that firefighters die earlier than the average person in the United States, more than half reported a belief that firefighters are at higher risk for heart disease and half reported a belief that firefighters are at higher risk for cancer. While there is evidence that firefighters are at higher risk for some types of cancer (LeMasters et al., 2006) and heart disease (Aronson, Tomlinson, & Smith, 1994; Bates, 1987; Feuer & Rosenman, 1986), there is not yet conclusive evidence about age of mortality among this population. As the scientific literature provides more conclusive data on the links between relative risk of disease and fire fighting, it will be important to educate fire service personnel about these dangers. Even if the scientific literature does not conclude that fire service personnel are at increased risk for disease or death, the nature of fire fighting should make health and wellness a priority as a means of reducing shared risk. As one firefighter stated, "when we hit the fire ground, your risk factors become my risk" (Mast, personal communication). Fireground medical emergencies place not only the compromised firefighter at risk, but also the rest of the crew who has to respond to the medical emergency in the context of an existing emergency situation.

The departments surveyed reported that they placed a good deal of emphasis on health and wellness as well as physical activity. However, when compared with the previous two constructs, the departments placed relatively less emphasis on proper nutrition. Only a third of firefighters reported that their on-duty nutrition habits are better than their off-duty nutrition habits.

Limitations to the Current Study

While the results provide an interesting snapshot of the health of firefighters, the study has limitations. For example, the survey was introduced to participants as a study focusing on firefighter health as it relates to cardiovascular risk factors. This introduction might have increased social desirability to some questions. Only two departments were solicited for participation and the departments were very different with regard to composition (one was a large primarily career suburban department while the other department was a smaller more rural department comprised of a mix of volunteers and career firefighters). Given this limitation, the generalizability of the results to the fire service as a whole is limited although the results offer some interesting findings for testing hypotheses.

Directions for Future Research

Our results provide guidance for future research. For instance, more attention needs to be paid to nutritional intake among firefighters and to the interplay between diet and physical activity as they relate to BMI and physical health in general. A more diverse range of departments should be solicited for participation in future studies so the impact of exogenous variables such as years of service, region (e.g., Midwestern, Eastern, Western, Southern), type of department (e.g., paid, volunteer, combination), departmental programs can more accurately be determined. In addition, actual physicals measuring height and weight and using other forms of body composition (e.g., percent body fat, waist circumference, etc.) would be useful in identifying the most representative measure of physical fitness. Also, more probing questions also need to be asked about topics such as nutrition and eating habits. In addition, ways that the occupation of fire fighting encourages or discourages good health habits should be explored.

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Review of:

Osborne, D. & Hutchinson, P. (2004). *The price of government: Getting the results we need in an age of permanent fiscal crisis*. New York: Basic Books. 370 pp. ($16.95 paperback).

Price of Government — "the amount of purchasing power a community is *willing* [italics added] to commit to its governments" (p.41).

With this rather obvious but erudite definition, Osborne and Hutchinson introduce the reader to the world of governmental financial responsibility in this vividly written, clear, and concise book. The authors waste no time in criticizing both liberals, who often raise taxes and initiate new programs and conservatives, who cut taxes and spending, as using well-worn "gimmicks" to delay the inevitable for yet another year . . . or least until after an election. Regardless, it embodies an inefficient practice of borrowing billions of dollars to fund a budget.

"American government is waist-deep in its worst fiscal crisis since World War II" (p.1). With this dire statement, the authors predict a bleak future for local governments. This "perpetual fiscal crisis" (as characterized by Ray Sheppach, the National Governor's Association's Executive Director) in the public sector is the result of a "colossally irresponsible president and Congress, an obsolete tax structure, an aging population, an ineluctable (unavoidable) rise in the cost of health care and continuing resistance to major tax increases" (p.2). Economic recovery will ease the pain, but not eliminate it.

In this "fix it" book, Osborne and Hutchinson confront the problem of fiscal stress by posing the following question as to how citizens can reap the most value for their taxes. They add that this issue cuts across party lines. It is neither a liberal nor a conservative concern — it is simply a matter of common sense.

Using the State of Washington as a model, the authors provide the means to securing better results through the use of "smarter sizing," management, and spending and work processes. They offer means to accomplish this objective based on five questions that must be addressed before a financial crisis can be solved:

1. Is the problem short or long term?
2. How much are citizens willing to spend?
3. What do citizens want for their money?
4. How much will the state spend to produce each of these results?
5. How best can that money be spent?

From these questions, Osborne and Hutchinson have drawn up ten approaches required to provide the means for solving a financial crisis.

The purpose of this review is not necessarily to critique this book, but rather to apply the authors' perspectives and principles to the fire service. Given the great void in fire-related literature with regard to finances and fiscal responsibility, *The Price of Government* provides a workable blueprint. Be forewarned, this outline may be a touch controversial to traditionalists in the fire service.

The fire service is well within the spectrum of the problems addressed by the authors. Fire departments throughout the nation are perennially fighting for a piece of an ever-shrinking municipal budget. Considering other interests also in the fight, such as education and health services, the battle is fierce. The question is not whether fire departments (chiefs) want to alter their strategies, but how to go about accomplishing it.

When all else fails, those entrenched in status-quo resort to the traditional across-the-board cuts, (the easy way out) which weaken every program (the fire service included). Furthermore, this approach seldom considers its impact on citizens. Genuine leadership is doing what must be done when you do not want to do it. Fire chiefs must consider Osborne and Hutchinson's ten approaches to better finances and apply them to the fire service. This may mean rethinking outside the so-called "traditional box," which has kept the profession in check for generations. (What is the saying: two hundred years of tradition unaffected by progress?) For the purposes of this discussion, consider Osborne and Hutchinson's principles, as applied to the fire service.

1. **Strategic Reviews: Divesting to Invest** — eliminate programs not central to the core. You cannot be everything to everyone.

Fire chiefs must carefully consider the services they deliver to the community. In a perfect world, there would be enough funding to support such services on a constant basis. It might now be time for fire officials to reconsider. This might be as simple as eliminating service calls or as complex as eliminating a fire department's response to medical calls by privatizing.

2. **Consolidation** — getting others (rowing organizations) to pay for certain services.

Charity sometimes begins at home. It might be an option for fire officials to advertise the need for equipment, for example, that could be purchased by private entities, especially the business sector. Donations are a way of life; start looking for assistance and remember, it is a tax write off for the donor.

3. **Rightsizing** — find the right size and then make sure your organization has the right mix to maximize the value delivered.

Steering is setting policy and direction; in other words, doing the right things. Rowing is service delivery and compliance; that is, doing things right. Fire departments, like governments, need to steer more and row less. This unfortunately might come in the form of rightsizing and an example could include adjusting apparatus staffing (always considering NFPA® standards). In a greater scheme, this could be achieved via regionalization or the amalgamation of several fire departments. Rightsizing equals consolidation which leads to regionalization -- a term that is verboten in some areas of the country. Tradition, in which the fire service is deeply steeped, has its advocates who equate any form of consolidation as dangerous to the fire service. Nevertheless, it is time to seriously consider the positive aspects of regionalization, even if it involves a sub-department of an organization. For example, think about amalgamating the mechanic departments in a city or town, or among several adjacent communities.

4. **Buying Services Competitively** — the fastest way to save money and increase value is to force public institutions to compete.

Did someone say privatization? Maybe it is time to study and analyze potential privatization strategies available to the fire service.

5. **Rewarding Performance, Not Good Intentions** — set performance targets at all levels, measure performance against them, and reward those who improve.

Any organization, the fire service included, can establish performance standards, whether they are response times or driving safety records, to name just two. Fire chiefs might also consider rewards for exemplary performances. Refer only to the last issue of this journal and its approach to reducing the line of duty deaths. Maybe wearing seatbelts should be a moot point, but until it becomes an afterthought, rewarding those who constantly wear them is something to consider.

6. **Smarter Customer Service: Putting Customers in the Driver's Seat** — Let customers choose between providers, rather then imposing services upon them.

Allow the public to choose what it wants or does not want. Must the fire service always think for the public and determine what is best? The answer might not always be "yes." In short, reflect on the public's wishes.

7. **Do Not Buy Mistrust; Eliminate It** — first win voluntary compliance by simplifying the rules.

Consider the creation of employee teams and let the fire personnel decide what is best. This management strategy works in large corporations such as General Motors; can it also work in the fire service? A fire chief might be surprised what those on the line and staff suggest for improvements. It is also the mark of an effective leader.

8. **Using Flexibility to Get Accountability** — "performance-based organizations" that have willingly accepted greater accountability in return for freedom from rules and regulations that impede performance.

Change rules that impede performance. How many chiefs really know what is happening on the line? Organize committees to look at changes that will improve the operation of the department and improve morale. Again, this is another characteristic of an effectual leader.

9. **Make Administrative Systems Allies, Not Enemies** — all organizations are prisoners of their own internal systems.

Modernize and streamline budget, accounting, personnel, procurement, and auditing processes. Consider several departments working together, both within a specific community or throughout the region.

10. **Smarter Work Processes: Tools from Industry** — organizations must ultimately change the way they work.

Fire departments can use total quality initiatives, for example. Business strategies can be applied to the fire service. What is successful in the business world can also be applied to the fire service.

In sum, the fire service does not and cannot exist in a vacuum. In a time of permanent fiscal scarcity, government generally and the fire service specifically can win the competition for public support only by delivering more value per dollar. It is not necessarily re-inventing the wheel, rather simply applying well-known and successfully employed principles to the fire service. Misters Osborne and Hutchinson have laid the groundwork; all that remains is the application.

One final note, this reviewer would be remiss if there was no comment on the author's superb chapter dedicated to leadership, especially considering the journal where this review appears. Chapter Fourteen entitled, "Leadership for a Change" outlines seven critical lessons which will help to win the battle for public support. They are as relevant to fire chiefs as they are to publicly elected officials. Ranging from a suggestion as simple as telling the truth, (did I say simple?) to more thought provoking suggestions as being willing to change everything short of values, this chapter should be included in any lesson plan of transformational as well as transactional leadership. Fire chiefs and college instructors, Nota Bene.

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