

**CONTRIBUTING FACTORS TO FIREFIGHTER  
LINE-OF-DUTY DEATH  
IN THE  
UNITED STATES**

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## **Abstract**

**Objective:** 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 death (LODD) in the United States. The identified contributing factors were to be examined for frequency of occurrence and clustering with other factors. Results are to be used to develop risk management programs for fire departments.

**Methods:** A retrospective study was conducted using data 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 Fire Fighters (IAFF). For each LODD, factors contributing to the death were recorded from federal investigations and eyewitness reports. The contributing factors were then analyzed for frequency of occurrence and clustering with other factors. Factors mentioned in less than 5% of the LODD cases were excluded from the cluster analysis. Factors and clusters were stratified according to department type, age of firefighter, scene type, population density of the jurisdiction (proxy for department size) and census region.

**Results:** There were 644 cases with sufficient information to be 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% 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% of all firefighter line-of-duty deaths during the years studied.

***Conclusions:***

Ninety-seven and one half 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.

***Keywords:*** LODD, contributing factor, risk management, firefighter

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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, FEMA, USFA, OSHA and 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. Fire fighter 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 fire fighters 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 death 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 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, 2007). 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**

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### **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 Fire Fighters (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 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 since 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 (DOJ/PSOB, 2006).

It is the position of the USFA that there is no established mechanism for identifying fatalities resulting from illnesses, such as cancer that develop 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 using the SAS software (Version 9.1, SAS Institute). Those contributing factors with no more than 5% *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**

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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)		
<b>Age</b>		
Less than 25	68	
25-35	89	
36-45	147	
46-55	191	
Greater than 55	145	
Unidentified	4	
<b>Gender</b>		
Male	620	(96%)
Female	24	(4%)
<b>Department Type</b>		
Career	252	
Volunteer	333	
Combination	58	
Other	1	
<b>Census Region</b>		
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 1882).
  
- **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). 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 unintentional 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 dataset and in various categories as described in Table 2 below.

**Table 2.**

<u>Dominant Contributing Factors by Strata (Top 3 Percentages shown)</u>	
<u>Strata</u>	<u>Contributing Factor (% LODD)</u>
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)

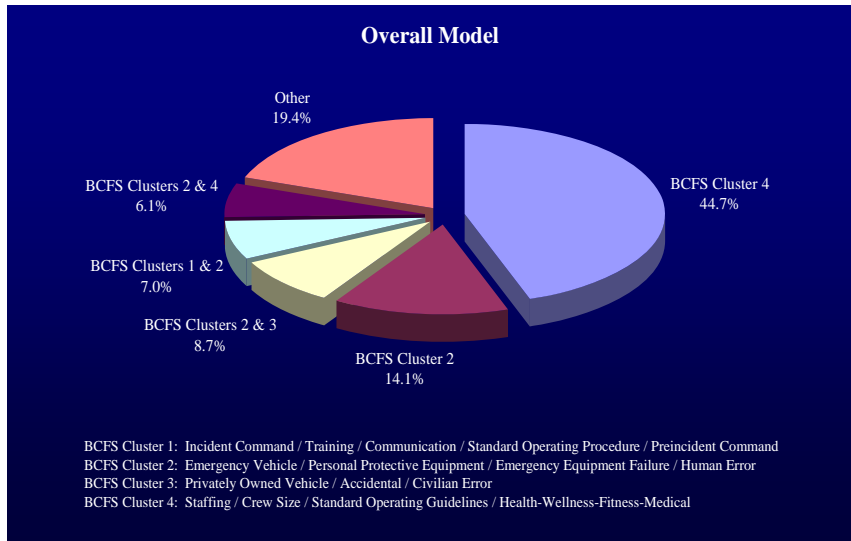
According to cluster analysis, four clusters of contributing factors were identified. Those contributing factors with no more than 5% *mentioned* were excluded from the cluster analysis. Composite cluster variables are listed in Table 3 below.

**Table 3 Composite Cluster Variables**

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

The four clusters identified by the analysis are responsible for 97.52% 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% of LODD. Cluster 2 alone is responsible for another 14.13%. A combination of Cluster 2 and Cluster 3 are responsible for an additional 8.70% of LODD. The remaining 32.45% of LODD are explained by another cluster alone or in combination as described in Figure 1 below.

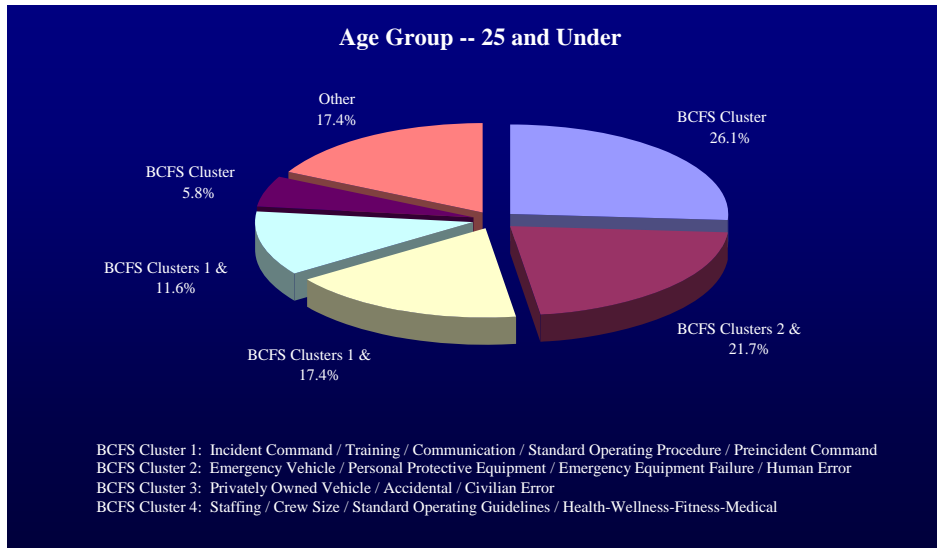
**Figure 1. Overall Model of Composite Clusters for LODD 2000-2005**



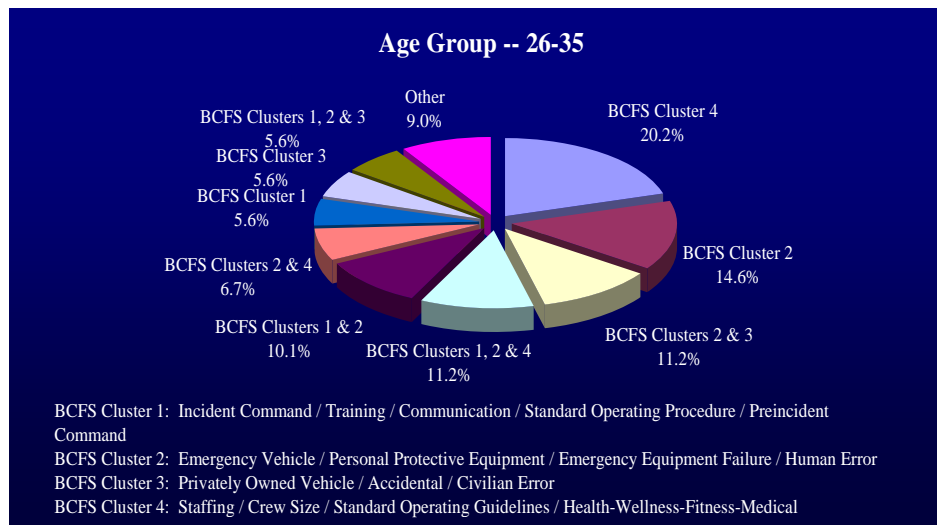
The relative contribution of these clusters within each stratum was evaluated as an attempt to hone contributing factor clusters to specific environments making risk management efforts more direct and efficient. Strata evaluated included firefighter age, type of department, census region, population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

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% of LODD in firefighters 25 and under while a combination of Clusters 2 and 3 was responsible for an additional 22%. 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% of LODD. Figures 2 – 6 show contributing factor clusters by firefighter age group.

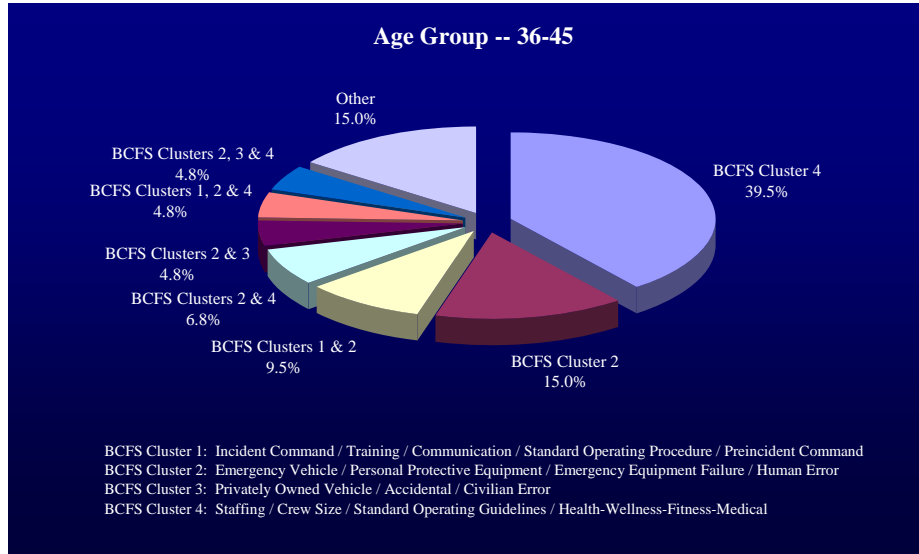
**Figure 2. Age Group 25 and Under**



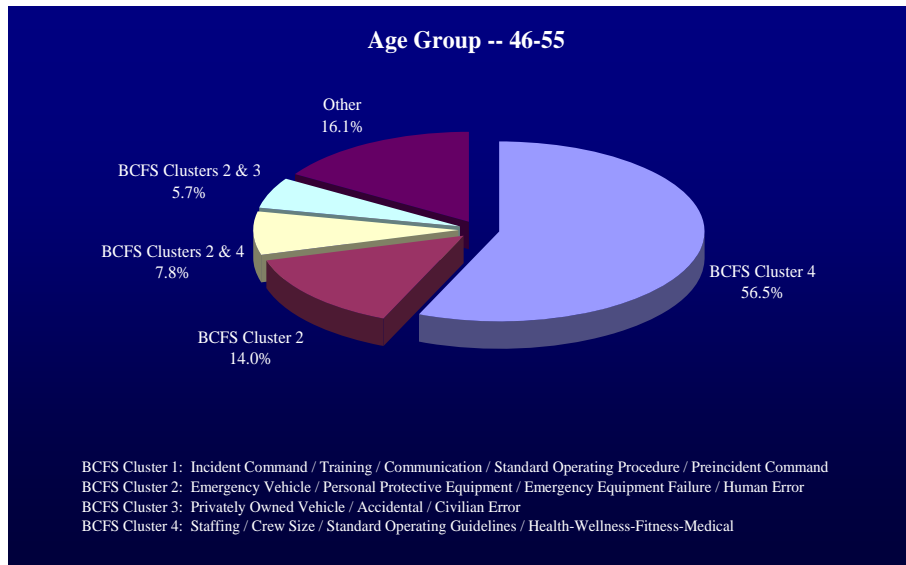
**Figure 3. Age Group 26-35**



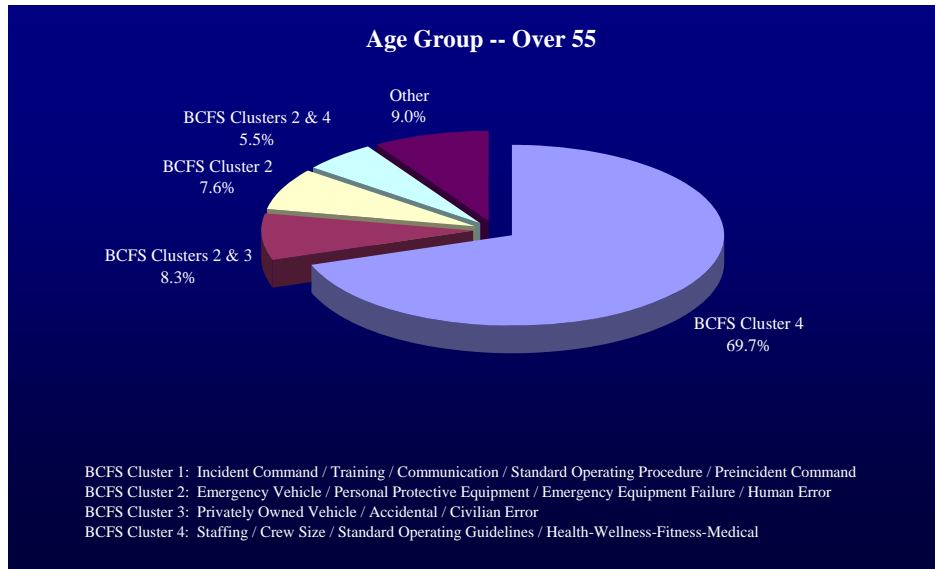
**Figure 4. Age Group 36-45**



**Figure 5. Age Group 46-55**

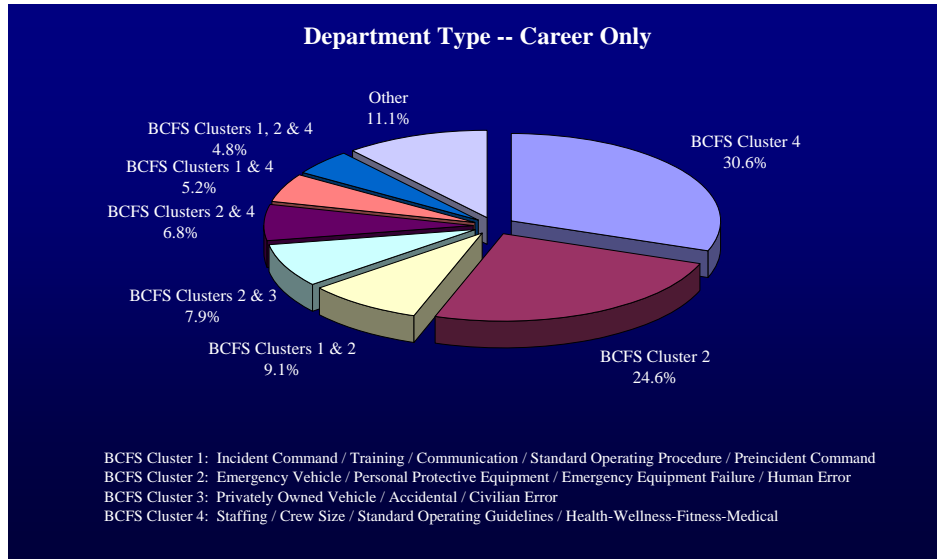


**Figure 6. Age Group Over 55**

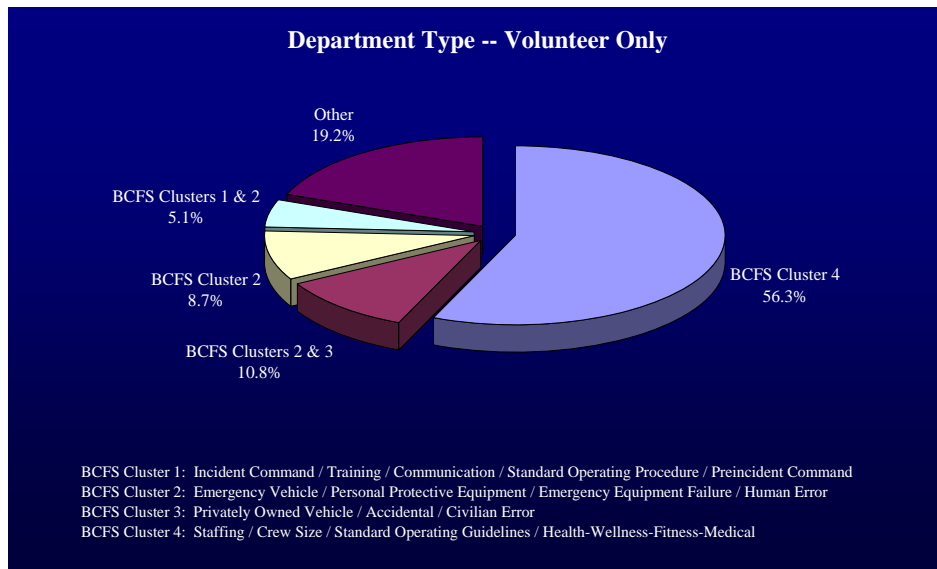


The next strata evaluated were department type. These strata were defined as career, volunteer and combination. Figures 7-9 show the contributing factor clusters most responsible for LODD in these strata. While Clusters 4 and 2 were responsible for half of LODD in Career Departments, Cluster 4 alone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

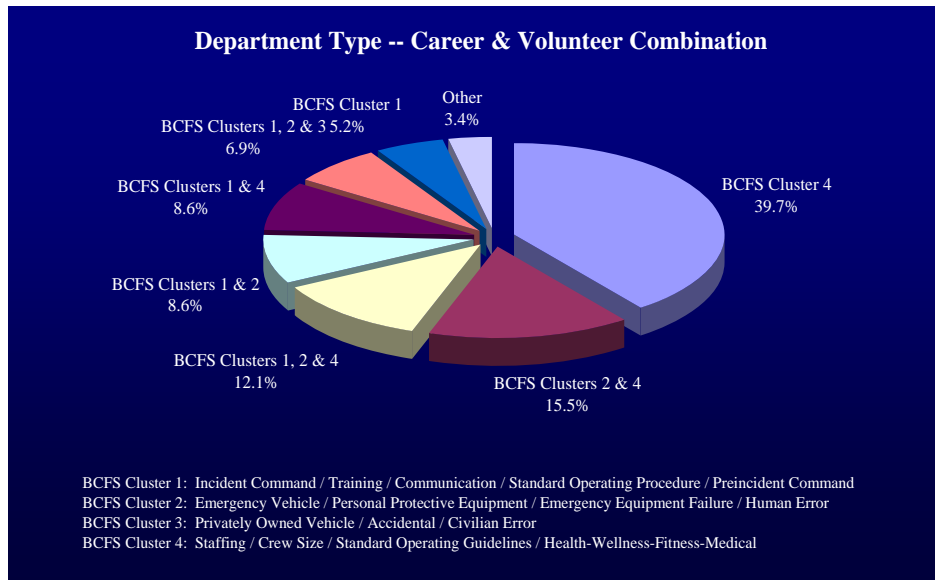
**Figure 7. Career Departments**



**Figure 8. Volunteer Departments**

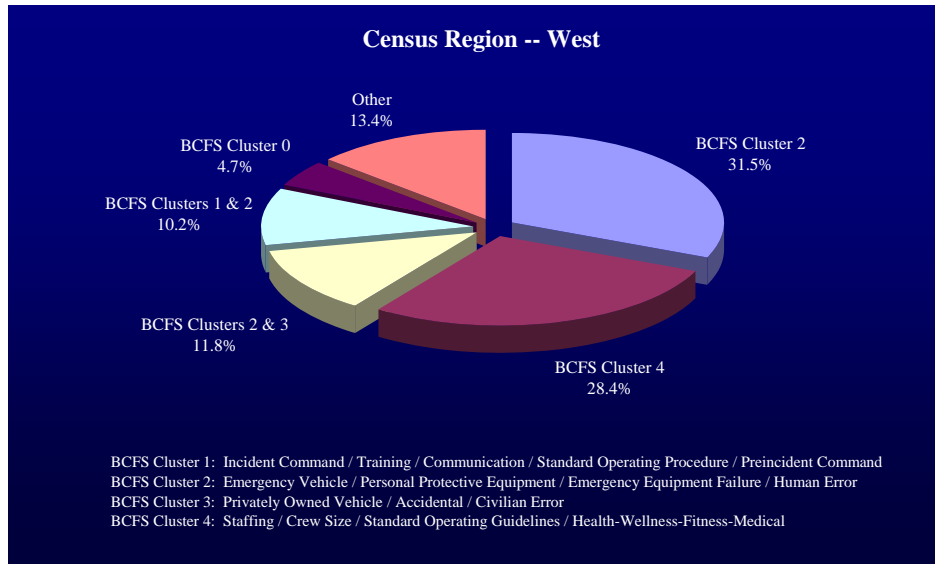


**Figure 9. Combination Departments**

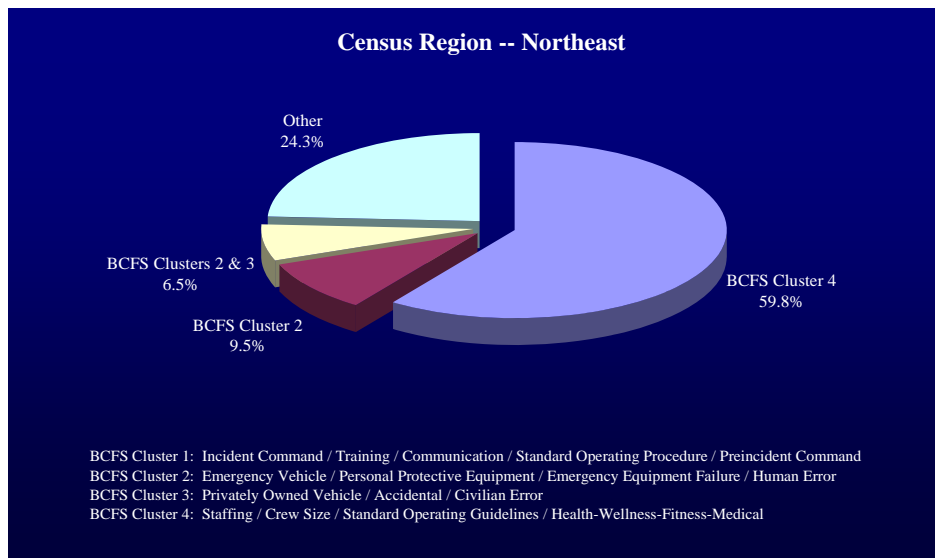


Data were also stratified by census region to highlight area differences in contributing factor clusters. These differences are significant, however reasons for the differences can only be assumed based on knowledge gained from fire industry experience. For example, the regional differences in the dominate 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 wellness/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.

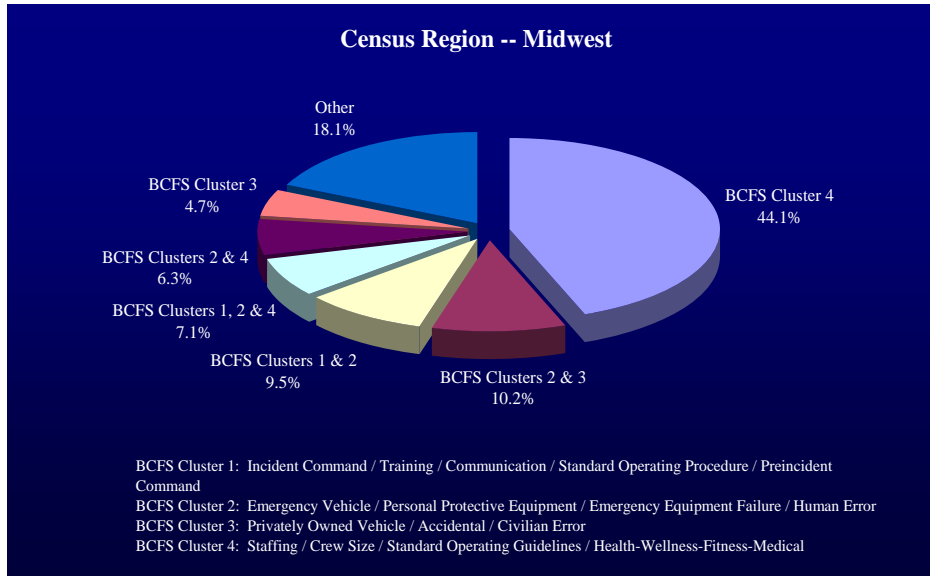
**Figure 10. West Region**



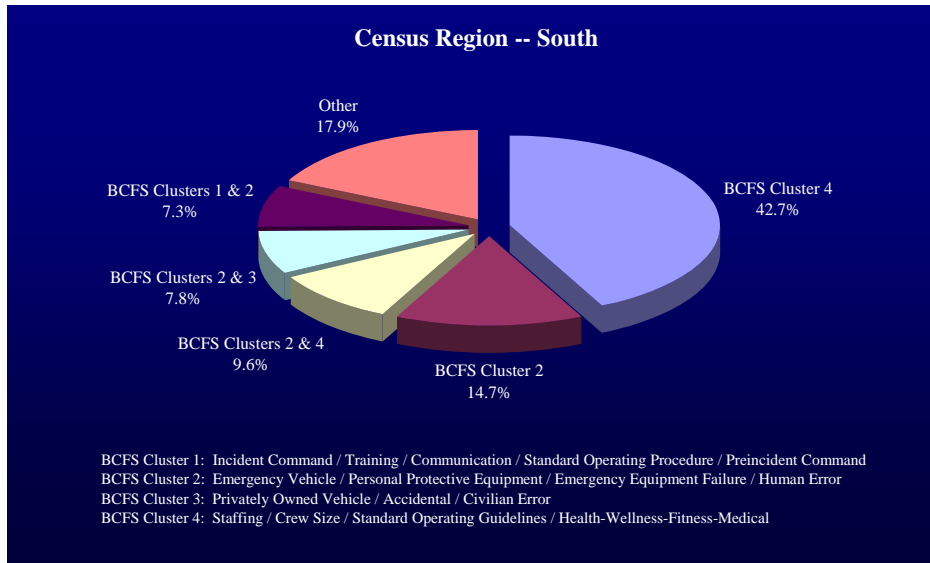
**Figure 11. Northeast Region**



**Figure 12. Midwest Region**



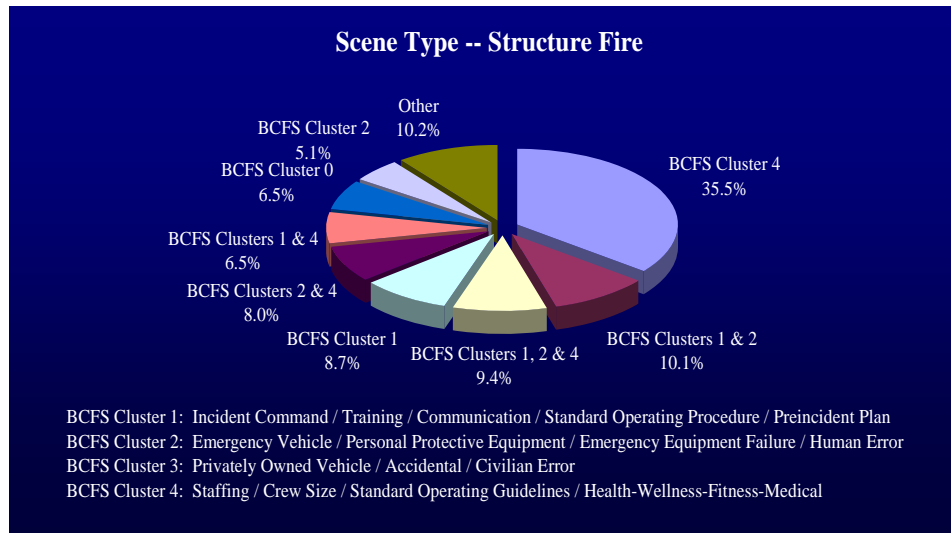
**Figure 13. South Region**



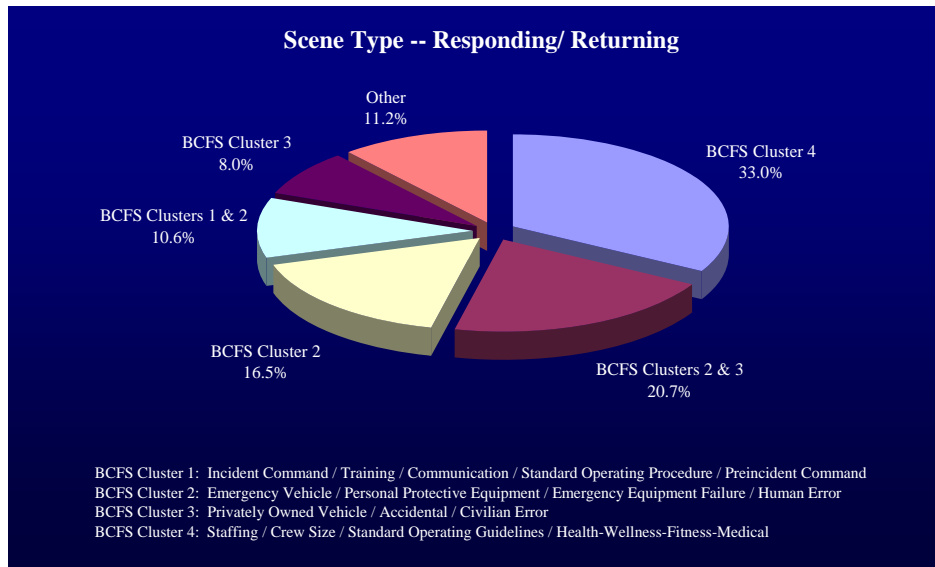
Data were also stratified by the population density in the jurisdiction of occurrence. Population density was used as a proxy for department size. Analysis of these strata was used to highlight differences in contributing factor clusters according to department size. Results show that there are no significant 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% of deaths while a combination of Clusters 1 and 2 are responsible for another 10.1%. In the stratum for responding/returning, Cluster 4 once again is dominant and responsible for 33% while a combination of Clusters 2 and 3 is responsible for another 20.7%. 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 (DOJ, 2006). The next scene type evaluated is training. The training stratum again shows Cluster 4 as dominant (45.7%) while Cluster 2, including personal protective equipment and human error, is responsible for an additional 20% 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.

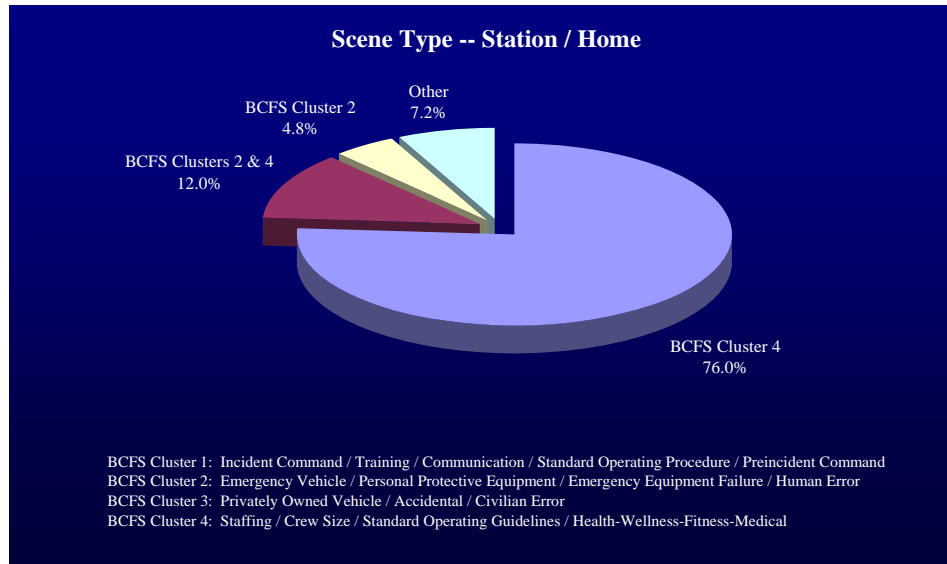
**Figure 14. Structure Fire**



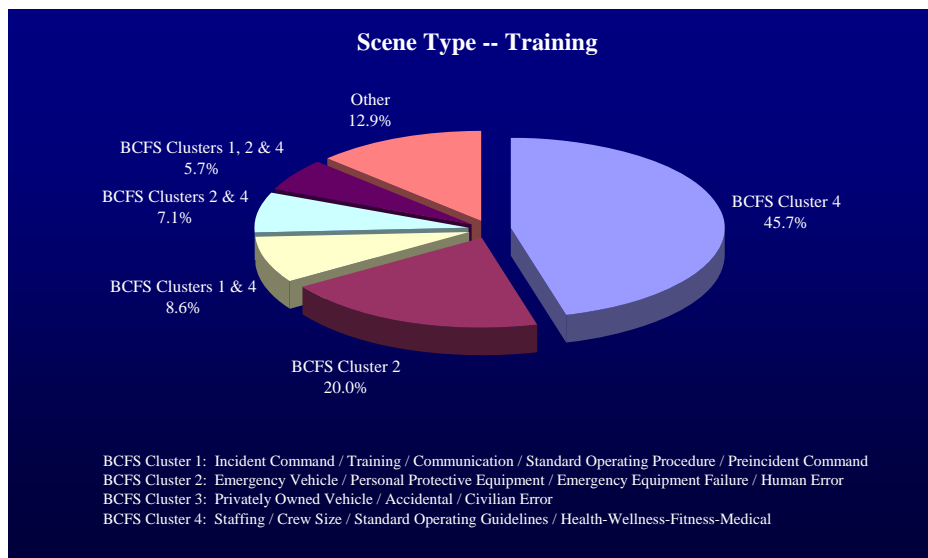
**Figure 15. Responding/Returning from Incident**



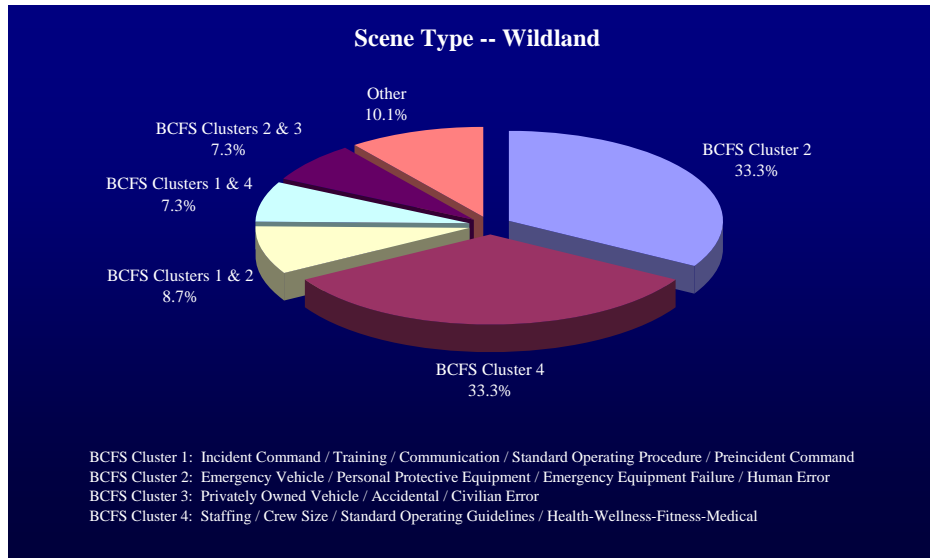
**Figure 16. Station/Home**



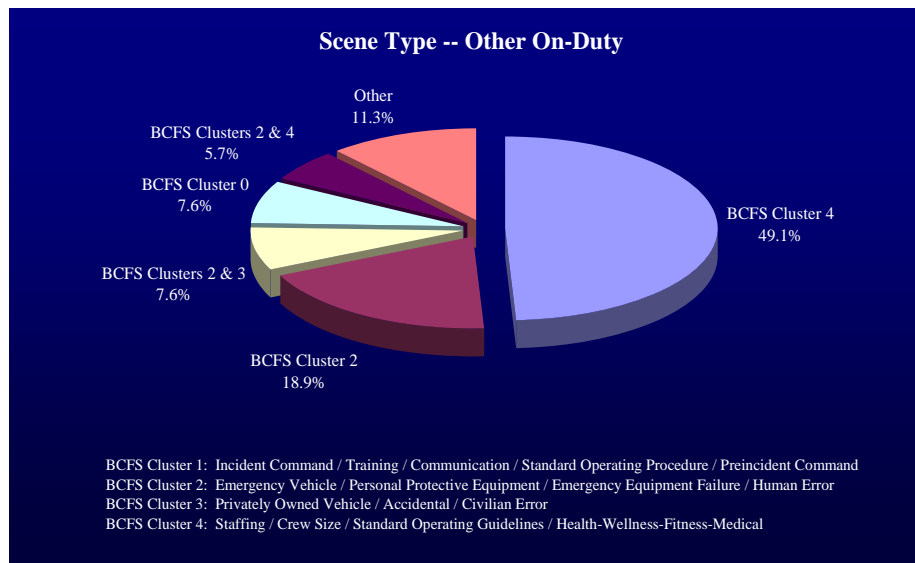
**Figure 17. Training**



**Figure 18. Wildland**



**Figure 19. Other On-Duty**



## **DISCUSSION**

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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).

Geographical Information System (GIS) analysis was used to produce map exhibits depicting the firefighter deaths. See Figures 20-24 below.

Figure 20 shows the location and frequency of firefighter deaths in the United States for the years 2000-2005. 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).

Figure 20 shows firefighter LODD by location and frequency

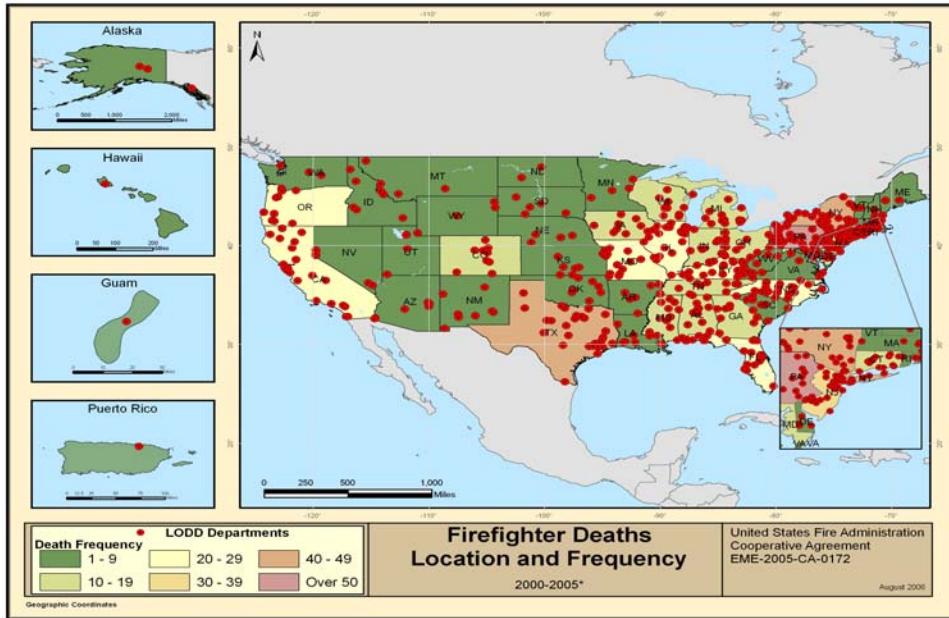


Figure 21 shows the location of firefighter deaths in the United States by census region for the years 2000-2005.

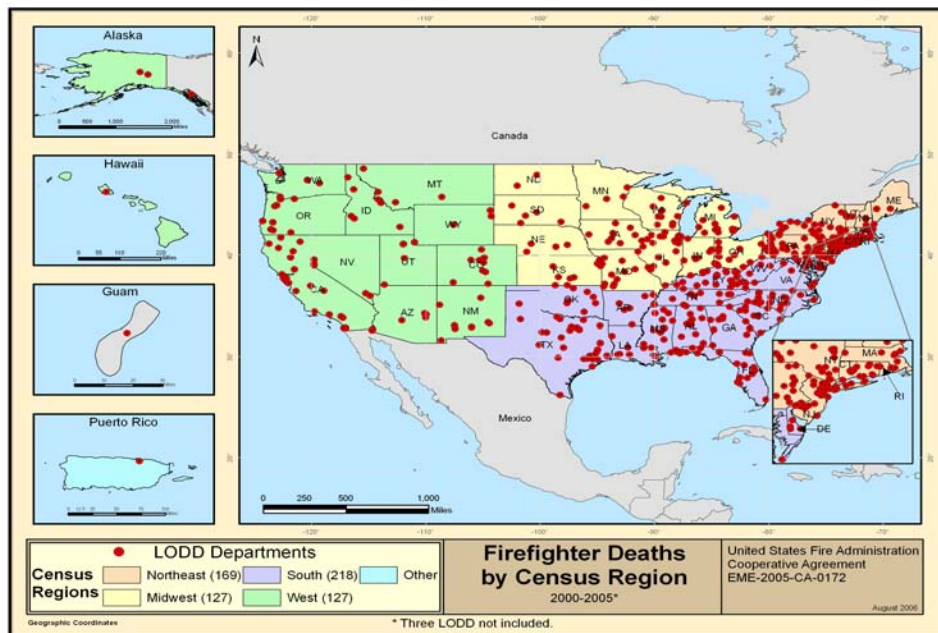
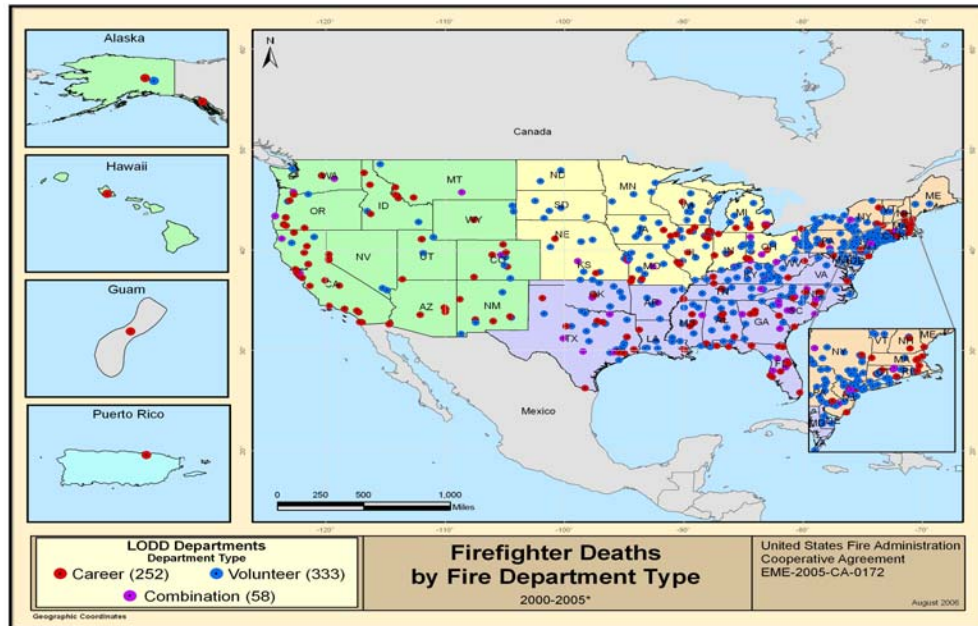




Figure 24 shows LODD in the United States for the years 2000-2005 by Fire Department Type and census region.



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 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 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%

\* 2.48% LODD were due to none of these clusters, and additional 6.83% LODD were due to more than two clusters and are not listed in this table.

## LIMITATIONS

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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 since non-mortality data were unavailable. 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

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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 health/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, health/wellness/fitness/medical status of firefighters and standard operating guidelines. Contributing factor clusters identified explain 97.52% 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.

## **Recommendations for Risk Management of Contributing Factors in Cluster 4**

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### **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, 18<sup>th</sup> 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 the IFSTA Pumping Apparatus Driver/Operator Handbook. (2<sup>nd</sup> 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 (pre-placement) 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 firefighting 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.

## **Recommendations for Risk Management of Contributing Factors in Cluster 2**

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### **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 device 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.

### **Recommendations for Risk Management of Contributing Factors in Cluster 3**

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#### **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.

## **Recommendations for Risk Management of Contributing Factors in Cluster 1**

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### **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 firefighting 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 fire ground 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 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 fire ground 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 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 firefighting, 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. Though 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.

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