Contributing Factors to Firefighter Line-of-Duty Death in the United States

By: Lori Moore-Merrell, DrPH, Ainong Zhou, PhD,
Sue McDonald, Elise Fisher, Jonathan Moore

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

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.

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 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 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 dataset 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)

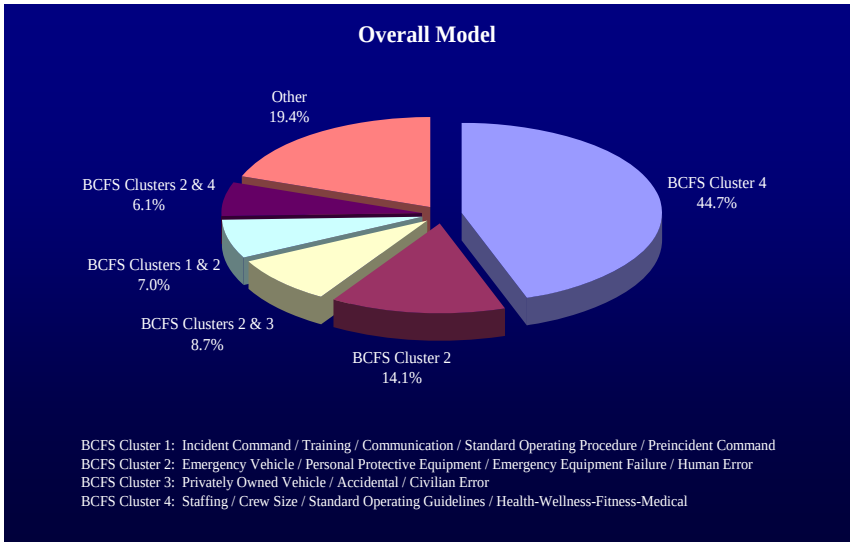
According to cluster analysis, four clusters of contributing factors were identified. Those contributing factors with no more than 5% *mentioned* were excluded from the cluster analysis. Composite cluster variables are listed in Table 3 below.

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% 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

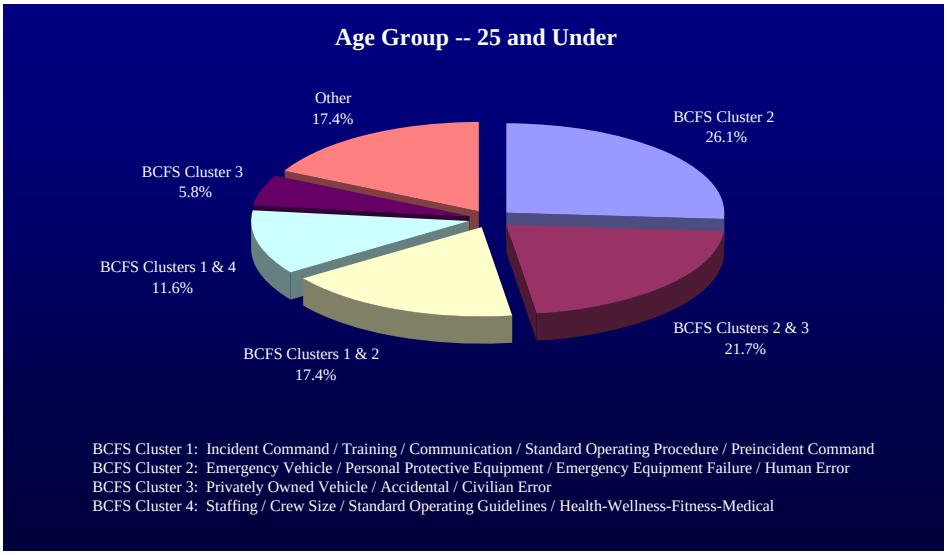


Figure 3. Age Group 26-35

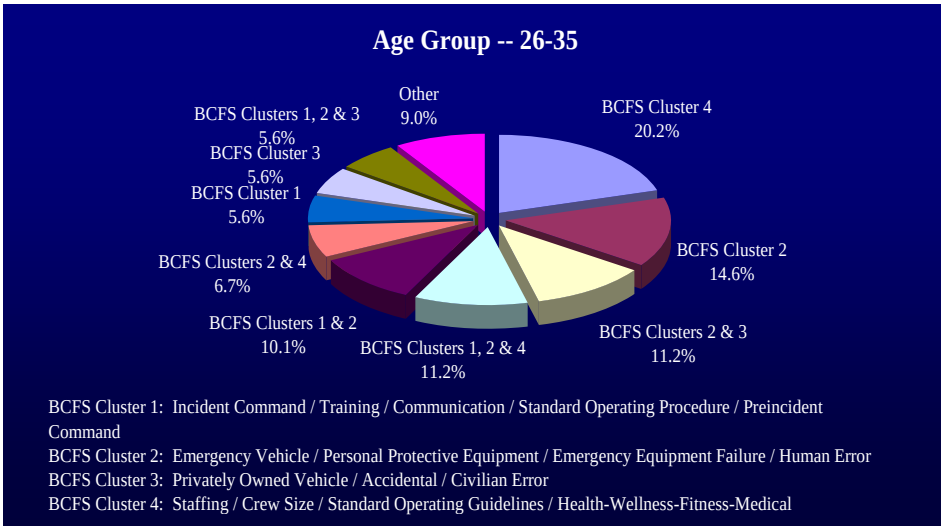


Figure 4. Age Group 36-45

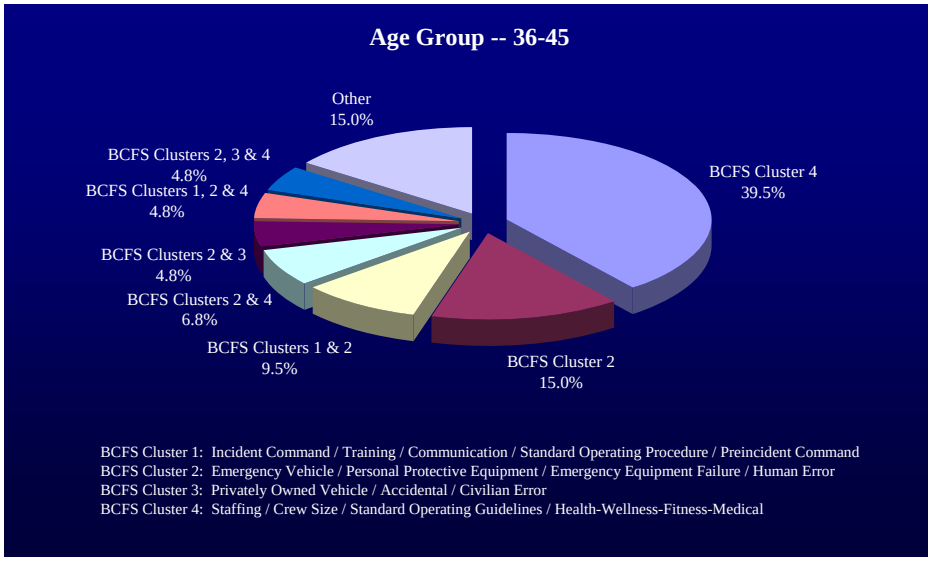


Figure 5. Age Group 46-55

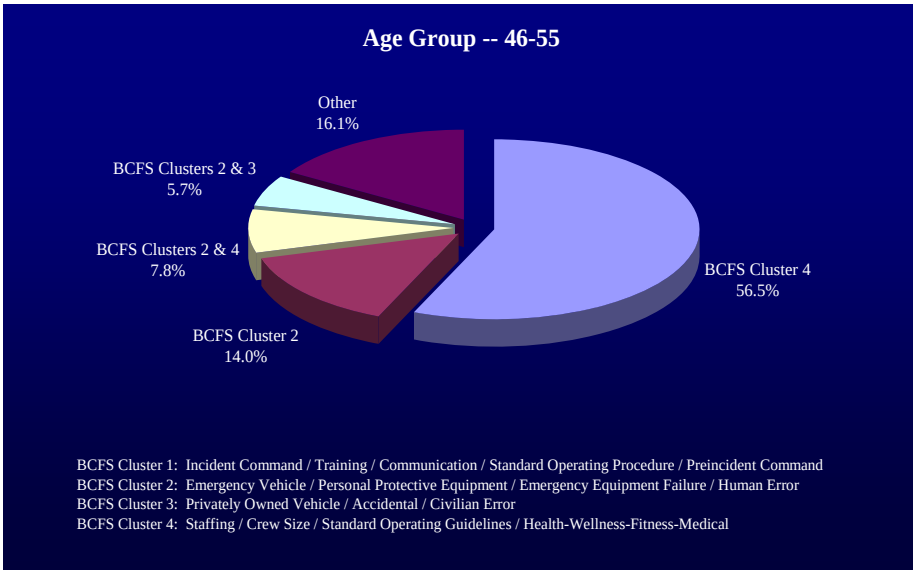
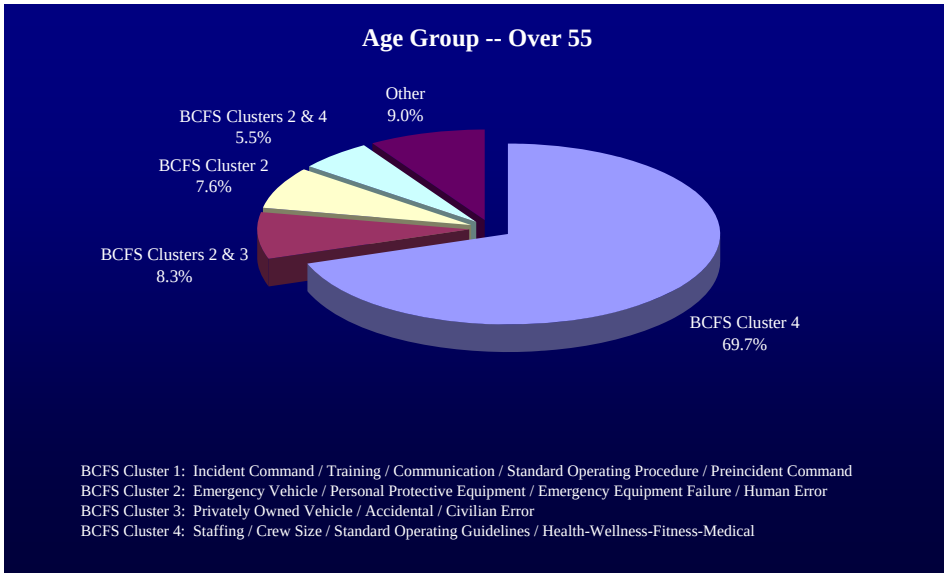


Figure 6. Age Group Over 55



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

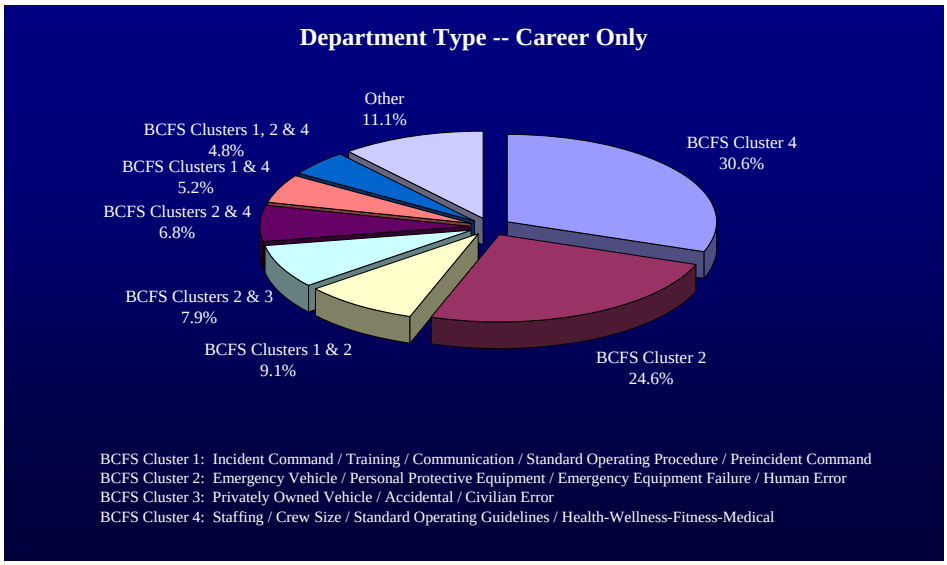


Figure 8. Volunteer Departments

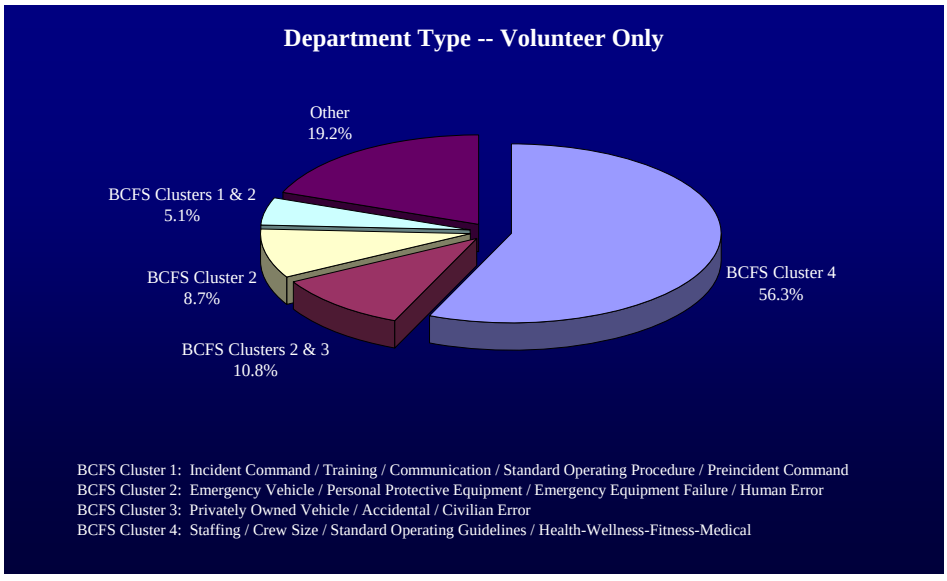
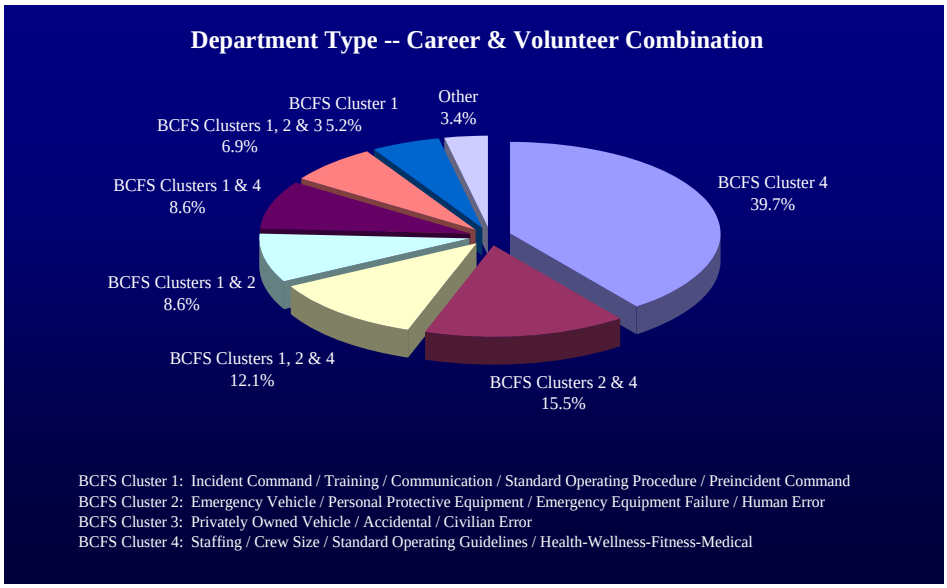


Figure 9. Combination Departments



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

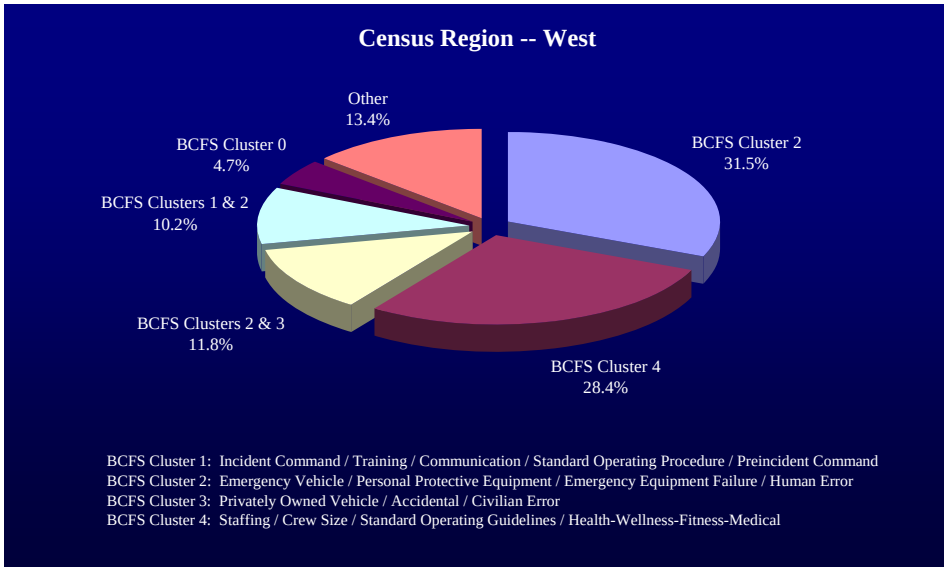


Figure 11. Northeast Region

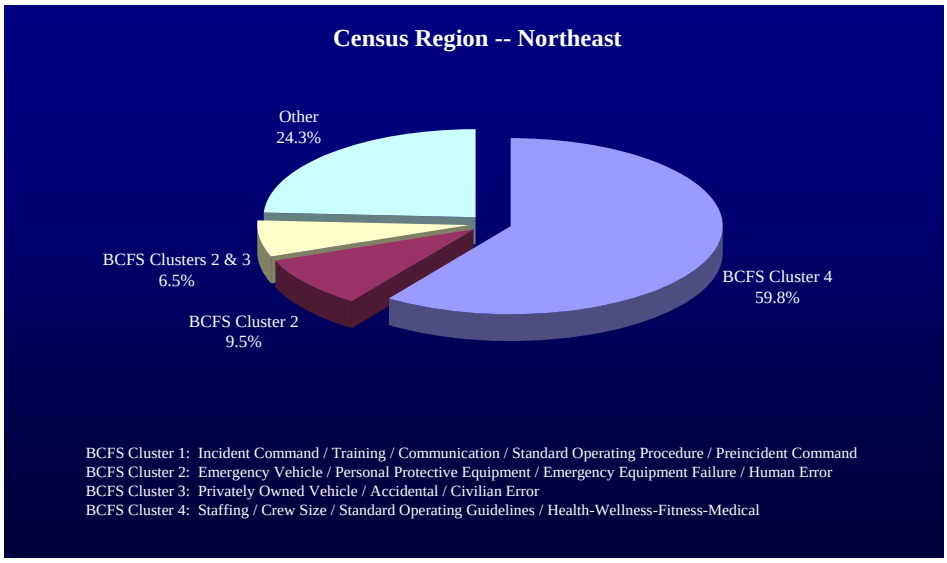


Figure 12. Midwest Region

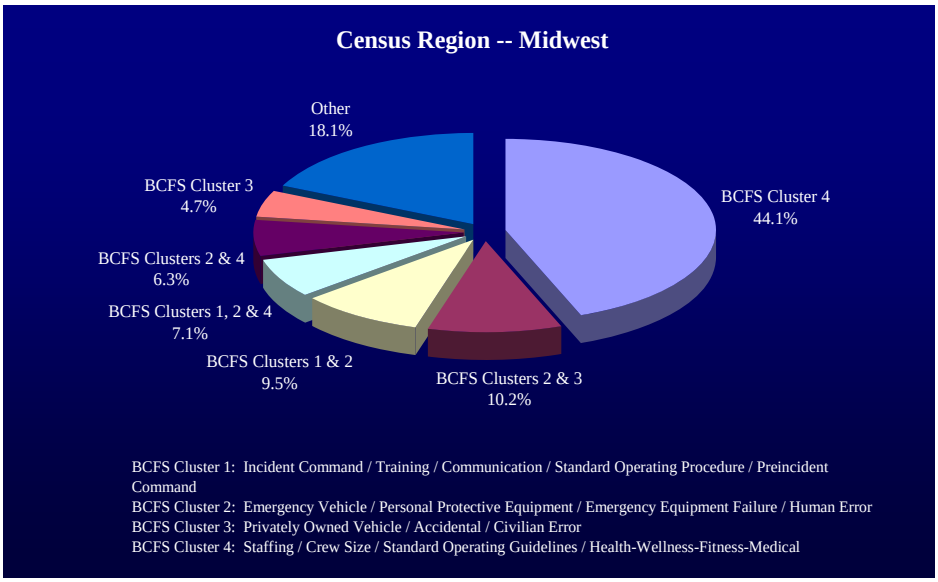
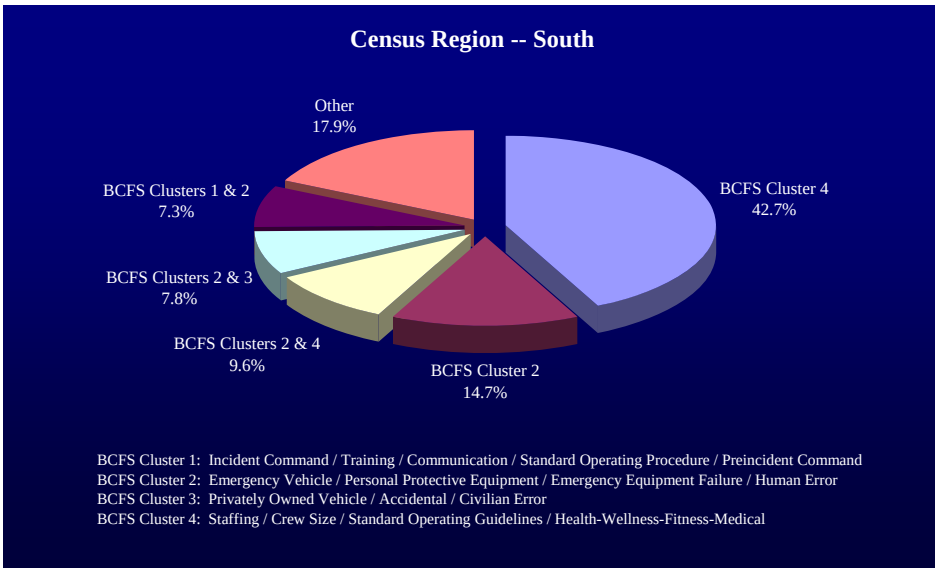


Figure 13. South Region



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 theses 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 dominate 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

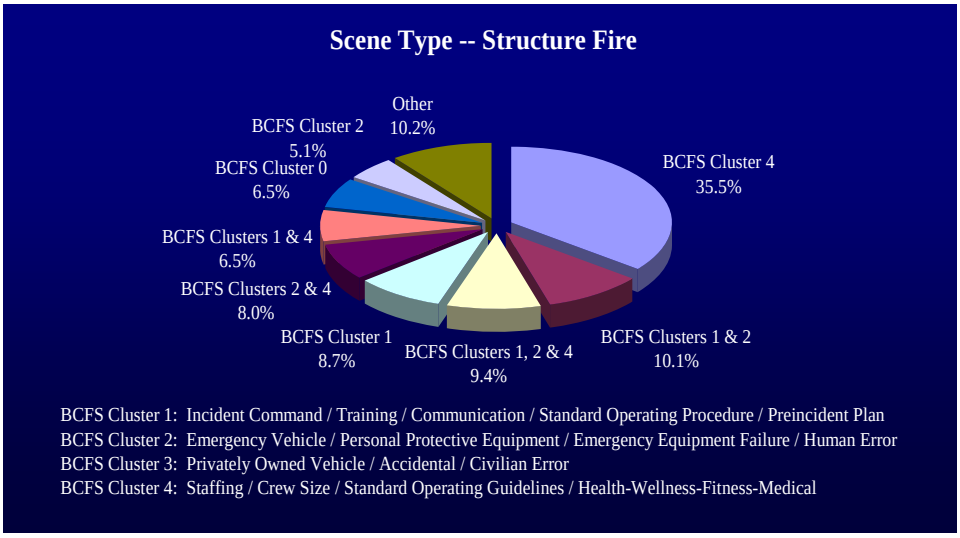


Figure 15. Responding/Returning from Incident

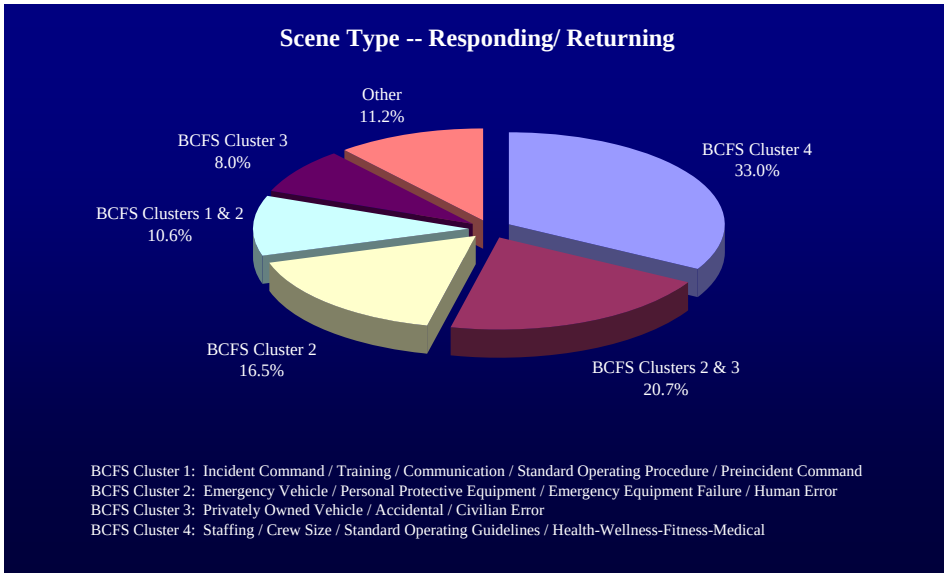


Figure 16. Station/Home

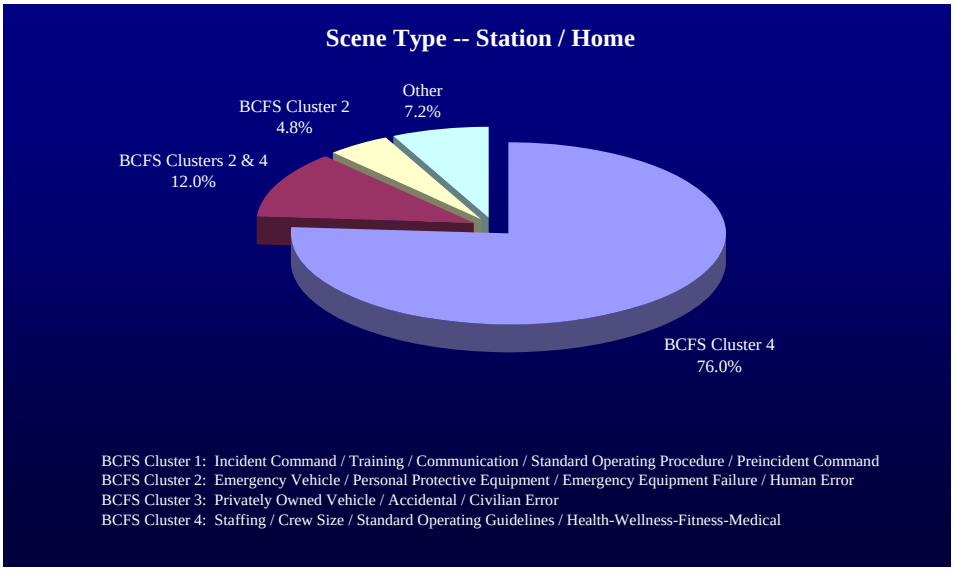


Figure 17. Training

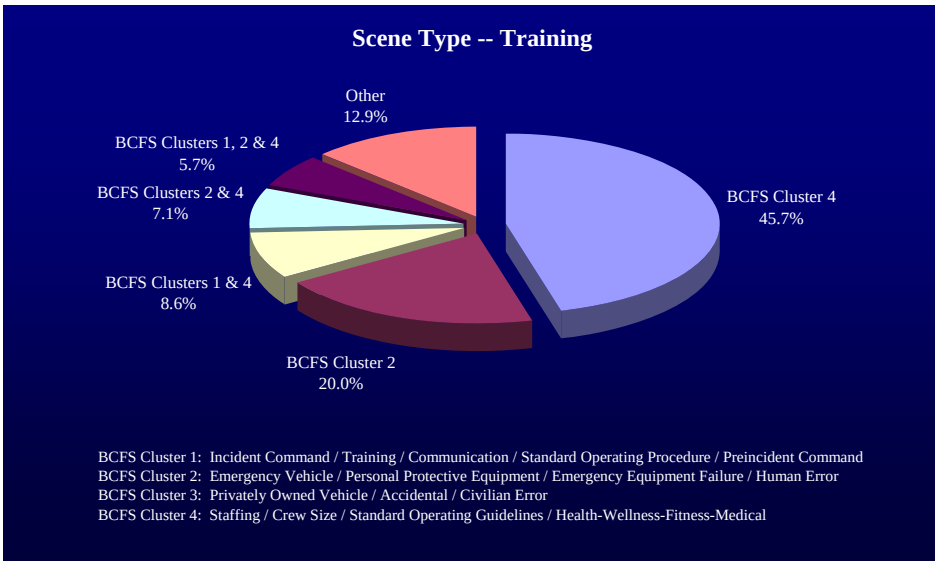


Figure 18. Wildland

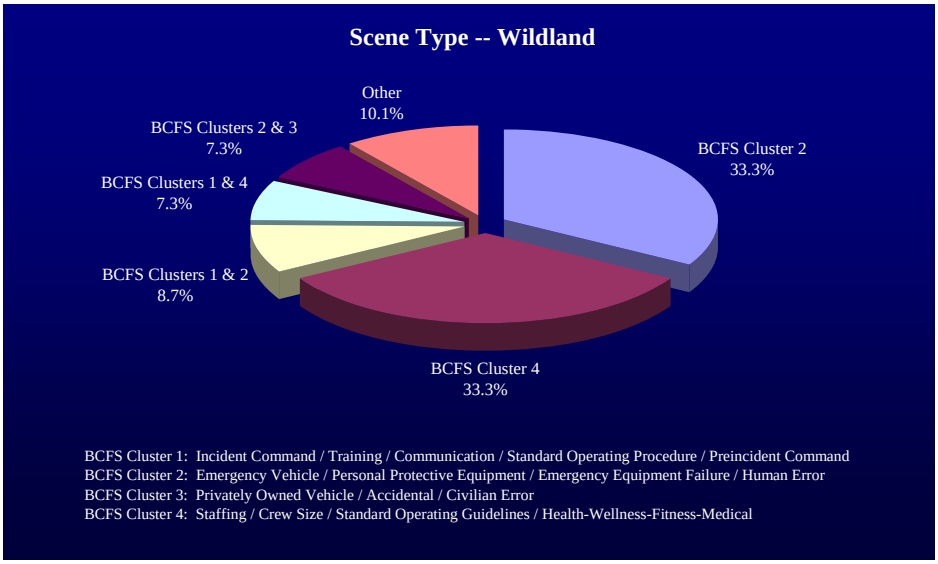
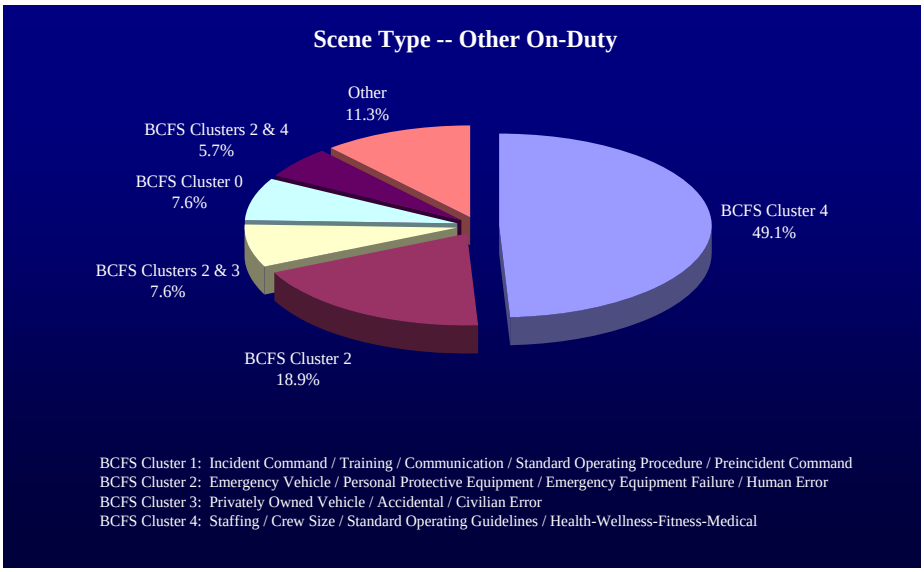


Figure 19. Other On-Duty



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% 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 have been compiled according to dominant contributing factor clusters. Each recommendation addresses management of a risk factor identified as

having contributed to an incident of firefighter LODD. These recommendations may be seen on the IAFF Website at www.iaff.org. Keyword search LODD.

REFERENCES

Federal Bureau of Investigation Report on Law Enforcement Officers Assaulted, www.fbi.gov/ucr/killed/2004/section2.htm.

NFPA Survey of Fire Departments for U.S Fire Experience, 2004.

U.S. Fire Department Profile Through 2003, NFPA, January 2005.

Firefighter fatalities in the U.S. 2004. Federal Emergency Management Agency, EME-2003-CO-0282, FA-299, August 2005

National Firefighter Near Miss Reporting System; http://www.firefighternearmiss.com/FAQ.htm (2007)

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.

NFPA Master Glossary of Terms, as used in Standards 1670, 424

NFPA Master Glossary of Terms, as used in Standards 1521, 1584

NFPA Master Glossary of Terms, as used in Standard 1982

NFPA Master Glossary of Terms, as used in Standard 1710; 3.3.8. 5.2.1 and 5.2.2 series.

National Interagency Fire Center, 2006

NFPA Master Glossary of Terms, as used in Standard 1410

NFPA Master Glossary of Terms, as used in Standards 600,601

NFPA Master Glossary of Terms, as used in Standards 130, 502, 1221

NFPA Master Glossary of Terms, as used in Standard 1521

NFPA 1620, 2003, ed.

NFPA Master Glossary of Terms, as used in Standard 1581

NFPA Master Glossary of Terms, as used in Standard 1670

NFPA Master Glossary of Terms, as used in Standard 402

NFPA Master Glossary of Terms, as used in Standard 1003

NFPA Master Glossary of Terms, as used in Standard 180

About the Authors

Lori Moore-Merrell, is an Assistant to the General President of the International Association of Fire Fighters (IAFF) in charge of Technical Assistance for Labor Issues and Collective Bargaining, Fire and EMS Operations, and IAFF Field Services. Lori's expertise is in emergency response system design, staffing and deployment of mobile resources, system performance measurement and evaluation. Dr. Moore-Merrell holds a Master of Public Health degree in Epidemiology and a Doctor of Public Health degree in Health Policy from The George Washington University. She is a professional presenter and author for topics related to fire and emergency medical response and operations as well as quality assessment and performance measurement. Dr. Moore-Merrell can be contacted by email at Lmoore@iaff.org.

Ainong Zhou, holds PhD's in Biostatistics and Immnobiology. He has over 8 years of experiences in clinical study protocol development and management, data management, data analyses in a variety of clinical trials and epidemiology studies. He serves as the lead statistician and statistical programmer in multiple clinical trials and epidemiological studies on infectious diseases, diabetes and strokes. He also engages in regular statistical consulting with researchers in firefighter studies, microarray data analysis, and cancer studies. Dr. Zhou is the author of more than 17 peer-reviewed papers on diabetes, malaria, and obesity, and is the expert to program in SAS, R, and other statistical software.

Sue McDonald-Valentine is a Research Assistant and data entry specialist in the Department of Labor Issues and Collective Bargaining for the International Association of Fire Fighters in Washington, DC.

Elise Fisher, MS, is a GIS programmer and emergency response system analyst with the Department of Fire and EMS Operations at the International Association of Fire Fighters, Washington, DC.

Jonathan Moore, BS, FF/EMT-P is the Director of the Department of Fire and EMS Operations/GIS with the International Association of Fire Fighters in Washington DC. Jonathan is a GIS programmer and Emergency Response System Analyst. He has evaluated more than 300 systems throughout the United States and Canada. Jonathan Moore can be contacted via email at Jmoore@iaff.org

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About the Symposium

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