RESEARCH

U.S. Volunteer Firefighter Injuries 2012-2014

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Abstract

Volunteer firefighters predominately protect communities with 10,000 population or less. On average during the period 2012 to 2014 injuries by type of duty, volunteers (51.6%) were more likely to receive injuries at the fireground than all firefighters combined (42.1%), and volunteers (13.5%) were less apt to be injured at non-fire emergencies than for all firefighters (21.2%). The leading types of injuries on the fireground were "strain, sprains, muscular pain", accounting for 2,105 injuries; "wound, cut, bleeding, bruise", accounting for 1,190 injuries; "frostbite and heat stroke", accounting for 755 injuries; and smoke or gas inhalation, accounting for 850 injuries. For all types of duty, "wound, cut, bleeding, bruise" and "strain, sprains, muscular pain" accounted for the largest shares of injuries. Volunteer firefighter injuries identified in this report may be preventable through training, equipment and safety programs/standard operating guidelines.

Keywords: volunteer firefighters, injuries, type of duty, nature of injury, injuries at the fireground, safety, fire departments,

Acknowledgements

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Background

This report analyzes national estimates of all firefighter injuries and a subset – volunteer firefighter injuries. Departments that protect communities of less than 10,000 population have a higher likelihood of being comprised of volunteer firefighters. [See Table A1 and Figure A1]. For the purpose of this report, all departments that protect communities of less than 10,000 population were categorized as 'volunteer' fire departments. Three years of data were analyzed to smooth annual variances and allow for trend analysis in categories with low annual occurrences. The estimated number of volunteer firefighter injuries, by type of duty and nature of injury, for the 2012-14 period are provided in Table 1.

Objective

The objective of the report was undertaken to compare the volunteer firefighter injury experience to all firefighter injuries. 'All firefighter injuries' refers to the combined career and volunteer firefighter injuries as estimated based on the NFPA National Fire Experience Survey and reported in the NFPA Annual Firefighter Injury Reports from 2012 to 2014. (For the latest report see: *U.S. Firefighter Injuries, 2014*).

Methods

The NFPA annually surveys a sample of fire departments in the United States to make national projections of the fire problem. The sample is stratified by the size of the community protected by the fire department. All U.S. fire departments that protect communities with a population more than 2,500 are included in the sample. The 13,412 departments in the nine highest strata protect a population of 289,207,946 or 91% of the U.S. population as of July, 2014. The rest of the sample included 7,687 randomly selected departments from stratum 10 (less than 2,500 population protected) for a total sample size of 21,399 or 71% of all known fire departments to the NFPA in the United States. A total of 2,972 departments responded to the 2014 fire experience survey. The national projections are made by weighting sample results according to the proportion of total U.S. population accounted for by communities of each size. Around any estimate based on a sample survey, there is a confidence interval that measures the statistical certainty (or uncertainty) of the estimate. We are confident the actual number of total firefighter injuries falls within 5.0% of the estimate. The results in this report are based on injuries that occurred during incidents attended by public fire departments. State and federal firefighting entities

were not included in this sample. No adjustments were made for injuries that occurred during fires attended solely by private fire brigades, such as: industrial or military installations.

Results

For injuries by type of duty, volunteers (51.6%) were more likely to receive injuries at the fireground than all firefighters combined (42.1%), and volunteers (13.5%) were less apt to be injured at non-fire emergencies than for all firefighters (21.2%). This is due, at least in part to the fact that many smaller departments protecting 10,000 population or less do not provide EMS service, so non-fire emergencies are a smaller component of their overall incidents, while fires are a larger component [see Table A3]. For the period 2013 to 2014 departments protecting greater than 10,000 population were between 16 and 30 times more likely to respond to a rescue/EMS incident relative to a fire incident; whereas departments protecting populations less than 10,000 population are 4 to 10 times more likely to respond to a rescue/EMS incident relative to a fire incident (See Table A2).

For injuries at the fireground 2012 - 2014, the leading types of injuries were strain, sprains, muscular pain, accounting for 2,105 injuries; wound, cut, bleeding, bruise, accounting for 1,190 injuries; frostbite, heat stroke, accounting for 755 injuries; and smoke or gas inhalation, accounting for 850 injuries. For all types of duty, wound, cut, bleeding, bruise and strain, sprains, muscular pain accounted for the largest shares of injuries.

Table 2 and Figure 2 provide a comparison by nature of injury and type of duty for all firefighter injuries and volunteers only. Wound, cut, bleeding, bruise injuries were more likely to occur for volunteers across all types of duty (18.0% to 26.5%) than for all firefighters (13.9% to 18.0%). Also from Table 2, injuries due to frostbite, or heat stroke were more likely to occur for volunteers across all types of duty (2.6% to 11.4%) than for all firefighters (0.9% to 5.6%).

The NFPA has previously identified that departments protecting smaller populations were less likely to have adequate or up to date personal protective equipment than departments protecting larger communities.[1]

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[1] Third Needs Assessment of U.S. Fire service, Quincy, MA: National Fire Protection Association, June 10, 2011, pp 82-86. Or available online: www.nfpa.org/needsassessment

Also at the fireground, smoke or gas inhalation accounted for a higher percentage of injuries for volunteers (12.9%) than for all firefighters (5.8%). The NFPA has previously identified departments protecting smaller communities were less likely to have adequate or up to date SCBA equipment than departments protecting larger communities. [2]

Causes of volunteer firefighter and all firefighter injuries at the fireground are provided in Table 3. The major causes of volunteer firefighter injuries were falls, jumps, slips, trips accounting for 1,580 injuries (25.3%) of volunteer injuries, overexertion, strain accounting for 1,205 injuries (19.3%), and exposure to fire products for 1,125 injuries (18.1%). Comparison of volunteer firefighter injuries to all firefighter injuries showed fairly similar results. The major differences in injury causes at the fireground between volunteer firefighters and all firefighters are: (1) exposure to fire products, 18.1% volunteer and 11.3% all firefighters; (2) overexertion, strain, 19.3% volunteer and 26.1% all firefighters; and (3) extreme weather, 6.9% volunteer and 3.3% all firefighters.

Both exposure to fire products and extreme weather can be explained by the fact that departments protecting smaller communities are less likely to have adequate or up to date personal protective equipment than departments protecting larger communities. The higher percentage of overexertion and strain injuries with all firefighters when compared to volunteer firefighter can be explained by the large number of rescue/EMS incidents relative to fire incidents fire departments that protect larger communities report. (see Table A2 in the Appendix).

Conclusions

There is a higher share of volunteer firefighter injuries on the fireground relative to all firefighters. This trend likely due to inadequate training, equipment and the condition of the equipment. Volunteer firefighter injuries such as strain, wounds, cuts, bleeding and bruising; smoke and gas inhalation and; frostbite, heatstroke continue to present a challenge to the volunteer firefighter community. Targeted training that addresses all four categories of exposures is warranted. NFPA maintains standards that may be relevant to volunteer fire departments in reducing injuries (see Table A4).

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[2] Same reference as 1, pp 77-80.

NFPA 1001 Standard for Firefighter Professional Qualifications is the basis for beginning level Firefighter I and II. This fundamental training teaches firefighters how to perform their job safely. Proper firefighter training would may prevent actions that might cause wounds, cuts, bruises, sprain and strains. Equally important is NFPA 1021 Standard for Fire Officer Professional Qualifications ; the fire officer directs fire operations has advanced training in fire behavior and additional response experience. Through this training the fire officer is enabled to instill a culture of safety upon the firefighters under their command, which may lead to reductions in injuries.

Another standard that has application for the volunteer fire service is NFPA 1051 Standard for Wildland Firefighter Professional Qualifications; many volunteer fire departments in rural areas respond to brush, grass, or forest fires. Understanding the aspects of the job as it relates to wildland firefighting is important to keeping volunteer members safe.

Specialized training as defined by NFPA 1404: Standard for Fire Service Respiratory Training presents an opportunity to the volunteer firefighting community to reduce smoke and gas inhalation exposures. Working in immediately dangerous to life and health (IDLH) atmospheres requires proper training and the use of self-contained breathing apparatus (SCBA). Initial and continuous training and competency checks should be frequent regardless of whether the department is career or volunteer.

With regards to frost bite and heatstroke injuries, the application of appropriate standard operating guidelines with respect to firefighter rehabilitation protocol may minimize firefighter exposure to this kind of environmental stress. NFPA 1584 Standard on the Rehabilitation Process for Members during Emergency Operations and Training Exercises is fundamental to reducing this type of injury. This standard will enable the fire department to design a rehabilitation plan for their members and reinforce the safety culture that every fire department needs in order to be successful in the execution of their duties.

In addition to training requirements, many injuries can be avoided through the application of adequate equipment replacement and maintenance schedules. See Appendix Table A3 to learn more about NFPA's public fire protection standards.

Table 1:
Firefighter Injuries by Type of Duty and Nature of Injury for Volunteers, 2012-2014 Average.

	Type of Duty					
Nature of Injury	Responding/ Returning	At the Fireground	At Non-Fire Emergencies	Training	Other On-Duty	Total
Burns	5	340	15	25	30	495
Smoke or gas inhalation	45	850	45	40	15	1,025
Other respiratory distress	5	235	25	60	5	370
Burns & smoke inhalation	0	135	35	10	0	210
Wound, cut, bleeding, bruise	285	1,190	340	495	360	3,065
Dislocation, fracture	130	320	85	115	90	830
Heart attack or stroke	65	110	10	15	30	255
Strain	465	2,105	880	810	640	5,875
Thermal	60	755	65	210	35	1,240
Other	145	560	220	90	195	1,505
Total	1,205	6,600	1,720	1,870	1,400	14,870
% for Volunteers only	9.3%	51.6%	13.5%	14.6%	11.0%	100.0%
% for All firefighters	7.6%	42.1%	21.2%	11.5%	18.7%	100.0%

Source: NFPA Annual Fire Experience Survey, 2012-2014

Volunteer firefighters injuries are based on results for departments that protect communities of less than 10,000 population which are comprised mostly of volunteer firefighters.

Table 2:
Firefighter Injuries by Type of Duty and Nature of Injury for All Firefighters and Volunteers Only, 2012-2014 Average.

	Type of Duty											
	Responding/Returning		At the Fireground		At Non-Fire Emergencies		Training		Other on-Duty		Total	
Nature of Injury	All Firefighters	Volunteer Only	All Firefighters	Volunteer Only	All Firefighters	Volunteer Only	All Firefighters	Volunteer Only	All Firefighters	Volunteer Only	All Firefighters	Volunteer Only
Burns	0.5%	0.2%	5.7%	5.2%	0.6%	0.7%	1.5%	1.3%	1.6%	2.2%	3.1%	3.2%
Smoke or gas inhalation	2.0%	3.6%	5.8%	12.9%	0.8%	2.5%	0.8%	2.3%	0.6%	0.9%	3.0%	7.8%
Other respiratory distress	0.8%	0.2%	1.7%	3.6%	1.0%	1.3%	1.7%	3.2%	1.2%	0.5%	1.4%	2.6%
Burns & smoke inhalation	0.1%	0.0%	1.2%	2.0%	0.4%	2.1%	0.5%	0.5%	0.3%	0.0%	0.7%	1.4%
Wound, cut, bleeding, bruise	17.8%	23.8%	13.9%	18.0%	14.6%	19.8%	18.0%	26.5%	17.9%	25.5%	15.5%	20.9%
Dislocation, fracture	4.9%	10.7%	2.8%	4.9%	2.0%	5.0%	4.6%	6.2%	2.7%	6.4%	3.0%	5.8%
Heart attack or stroke	2.8%	5.5%	0.9%	1.7%	6.8%	0.7%	1.2%	0.9%	2.1%	2.1%	1.2%	1.8%
Strain, sprain, muscular pain	55.3%	38.8%	50.6%	31.9%	60.6%	51.1%	59.6%	43.2%	55.1%	45.7%	54.9%	38.3%
Frostbite, heat stroke	3.0%	5.0%	5.6%	11.4%	1.0%	3.8%	5.6%	11.1%	0.9%	2.6%	3.6%	8.8%
Other	12.7%	12.1%	11.8%	8.5%	18.3%	12.9%	6.5%	4.9%	17.6%	14.0%	13.7%	9.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: NFPA Annual Fire Experience Survey, 2012-2014

Volunteer firefighters injuries are based on results for departments that protect communities of less than 10,000 population which are comprised mostly of volunteer firefighters.

Table 3:
Causes of Volunteer Firefighter Injuries at the Fireground, 2012-2014 Average.

Cause of Injury	Volunteer Only		All Firefighters	
	Number	Percent	Number	Percent
Exposure to fire products	1,125	18.1%	2,615	11.3%
Exposure to chemicals, etc.	160	2.5%	540	2.3%
Fall, jump, slip, trip	1,580	25.3%	5,600	24.2%
Overexertion, strain	1,205	19.3%	6,040	26.1%
Contact with object	870	14.0%	2,575	11.1%
Struck by	240	3.8%	1,210	5.2%
Extreme weather	430	6.9%	760	3.3%
Other	630	10.1%	3,815	16.5%
Total	6,240	100.0%	23,155	100.0%

Source: NFPA Annual Fire Experience Survey, 2012-2014

Volunteer firefighter injuries are based on results for departments that protect communities of less than 10,000 population these departments are comprised mostly of volunteer firefighters.

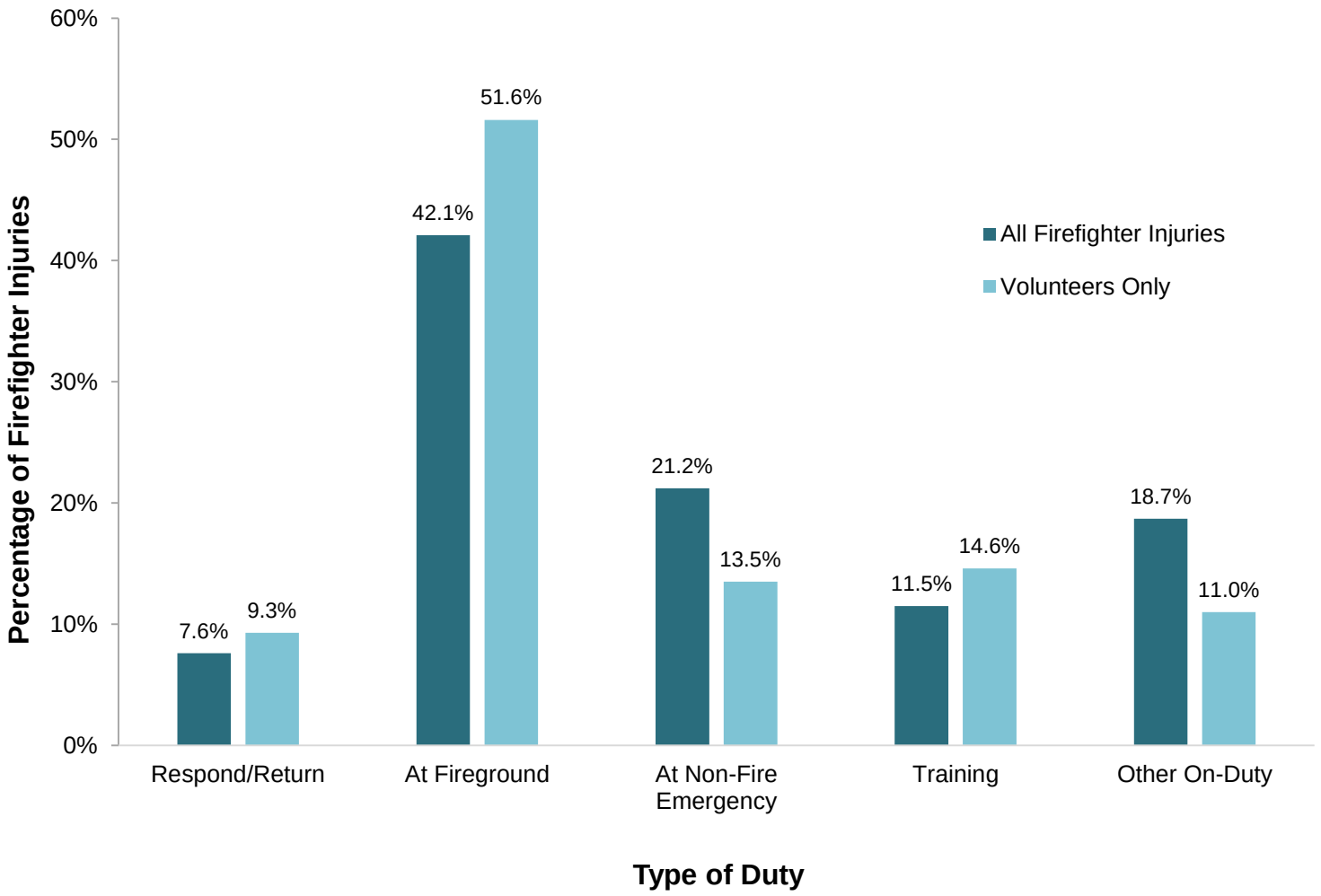

Figure 1: Firefighter Injuries by Type of Duty for All Firefighters and Volunteers Only.
Source: NFPA Annual Fire Experience Survey, 2012-2014.

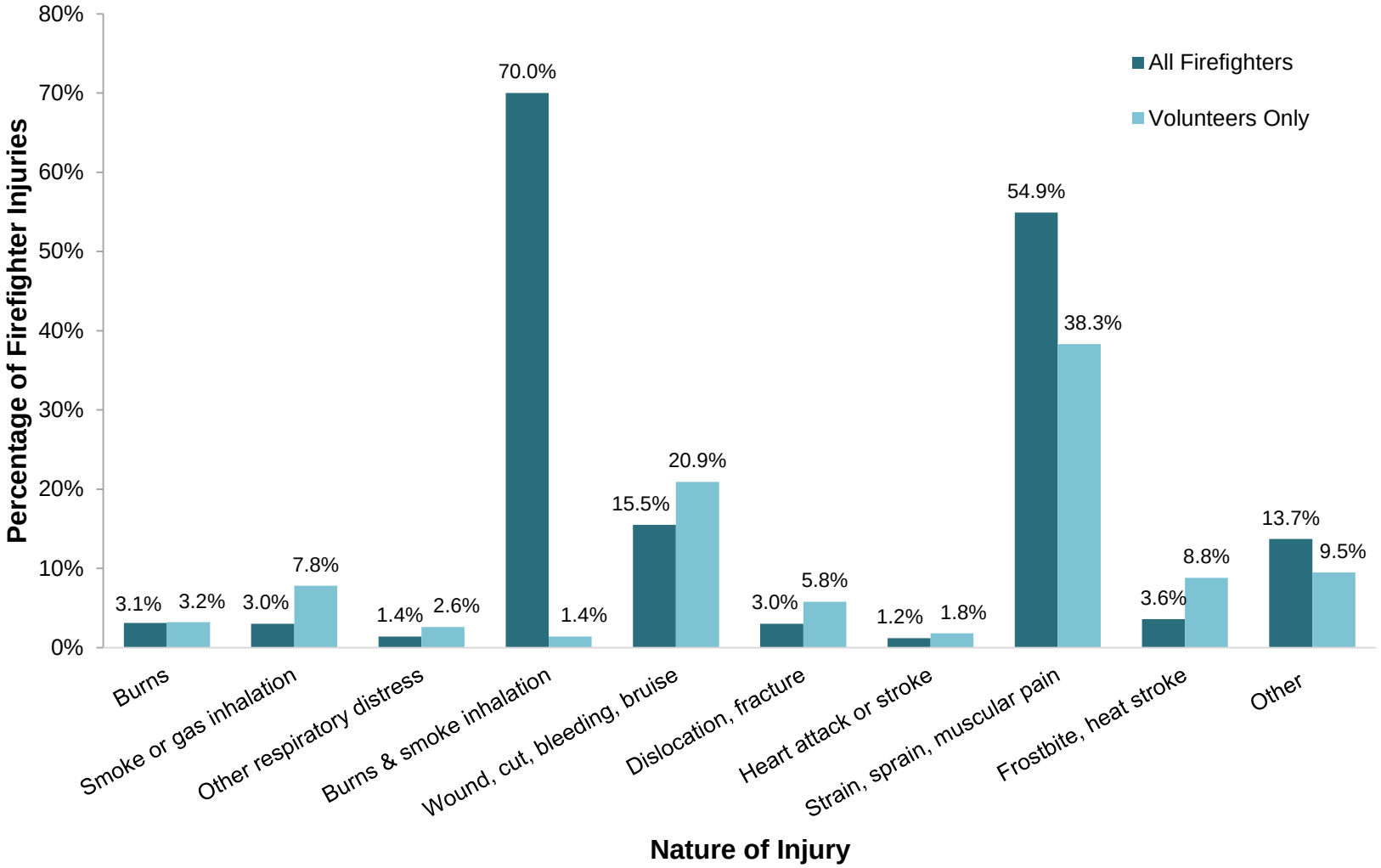

Figure 2: Nature of Injury for All Firefighters and Volunteers Only.
Source: NFPA Annual Fire Experience Survey, 2012-2014

Appendix

Table A1:
Department Type by Population Protected, 2014.

Population Protected	Type of Department (Percent) All Career	Mostly Career	Mostly Volunteer	All Volunteer	Total
1,000,000 or more	69.2%	30.8%	0.0%	0.0%	100.0%
500,000 to 999,999	71.4	23.8	4.8	0.0	100.0
250,000 to 499,999	78.6	14.3	3.6	3.6	100.0
100,000 to 249,999	81.3	15.9	2.8	0.0	100.0
50,000 to 99,999	63.0	22.7	13.4	0.9	100.0
25,000 to 49,999	46.0	27.2	21.0	5.9	100.0
10,000 to 24,999	21.7	24.2	38.0	16.2	100.0
5,000 to 9,999	5.5	9.4	38.4	46.7	100.0
2,500 to 4,999	1.7	1.7	25.6	71.0	100.0
Under 2,500	0.6	0.9	5.3	93.3	100.0
All Departments	8.1	6.8	18.6	66.4	100.0

Source: NFPA Survey of Fire Departments for U.S. Fire Experience, 2014.

Type of department is broken into four categories. All career departments are comprised of 100% career firefighters. Mostly career is comprised of 51 to 99% career firefighters, while mostly volunteer is comprised of 1 to 50% career firefighters. All volunteer departments are comprised of 100% volunteer firefighters.

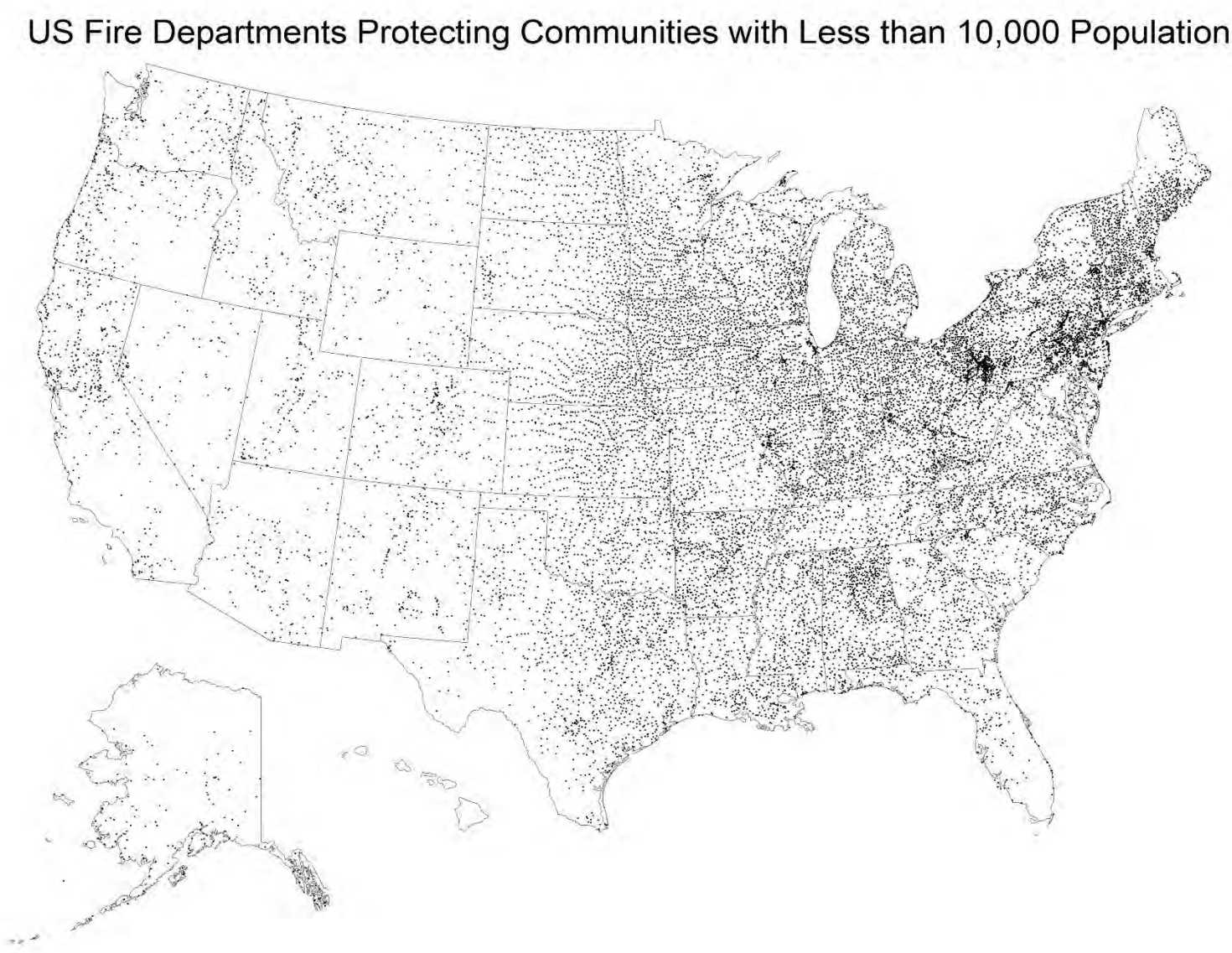

Figure A1: Locations of fire departments that protect populations less than 10,000. Source: NFPA Fire Service Survey, 2011-2013.

Table A2:
Average Number of Fires and Non-Fire Incidents by Community Size, 2012-2014.

	Community Size									
	1,000,000 or more	**500,000 to 999,999**	**250,000 to 499,999**	**100,000 to 249,999**	**50,000 to 99,999**	**25,000 to 49,999**	**10,0000 to 24,999**	**5,000 to 9,999**	**2,500 to 4,999**	**under 2,500**
Fires	4,597	2,308	988	464	191	106	60	34	23	11
Rescue, EMS etc.,	138,135	64,073	22,857	12,405	4,842	1,944	979	337	164	43
False alarm responses	15,180	5,556	2,110	1,222	567	304	136	54	21	5
Mutual aid responses	1,672	1,198	647	347	196	133	86	55	32	12
Hazardous materials	1,782	779	308	177	84	50	25	11	4	1
Other hazardous	2,108	1,082	594	285	147	72	37	19	9	2
All other responses	83,899	12,631	6,606	2,715	1,139	481	206	78	29	7
Total	252,172	87,559	34,109	17,487	7,003	3,122	1,509	581	278	76

	1,000,000 or more	**500,000 to 999,999**	**250,000 to 499,999**	**100,000 to 249,999**	**50,000 to 99,999**	**25,000 to 49,999**	**10,0000 to 24,999**	**5,000 to 9,999**	**2,500 to 4,999**	**under 2,500**
Fires	1.8%	2.6%	2.9%	2.7%	2.7%	3.4%	4.0%	5.8%	8.3%	13.8%
Rescue, EMS etc.,	54.8%	73.2%	67.0%	70.9%	69.1%	62.3%	64.9%	57.9%	59.1%	56.6%
False alarm responses	6.0%	6.3%	6.2%	7.0%	8.1%	9.7%	9.0%	9.3%	7.6%	6.6%
Mutual aid responses	0.7%	1.4%	1.9%	2.0%	2.8%	4.3%	5.7%	9.5%	11.5%	15.1%
Hazardous materials	0.7%	0.9%	0.9%	1.0%	1.2%	1.6%	1.7%	1.8%	1.3%	1.3%
Other hazardous	0.8%	1.2%	1.7%	1.6%	2.1%	2.3%	2.4%	3.2%	3.2%	2.6%
All other responses	33.3%	14.4%	19.4%	15.5%	16.3%	14.9%	13.7%	13.4%	10.5%	9.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: NFPA's Survey of Fire Departments for U.S. Fire Experience (2013-2014)

Table A3:
Departments Providing Emergency Medical Service, by Community Size (Percent), 2012-2014.

Population Protected	No EMS	BLS	ALS	Total
1,000,000 or more	0.0%	0.0%	100.0%	100%
500,000 to 999,999	0.0	31.7	68.3	100%
250,000 to 499,999	1.6	27.0	71.4	100%
100,000 to 249,999	2.8	34.3	63.0	100%
50,000 to 99,999	6.4	37.3	56.3	100%
25,000 to 49,999	16.8	37.3	46.0	100%
10,000 to 24,999	27.1	41.3	31.6	100%
5,000 to 9,999	38.5	43.2	18.3	100%
2,500 to 4,999	41.2	46.5	12.2	100%
under 2,500	45.5	48.5	6.1	100%
Nationwide	39.0	45.6	15.5	100%

Source: NFPA Fire Service Survey, 2012-2014.

BLS refers to fire departments providing basic life support and ALS refers to fire departments providing advanced life support.

Table A4:

Title	Current Edition
NFPA 1001 Standard for Fire Fighter Professional Qualifications	2013
NFPA 1021: Standard for Fire Officer Professional Qualifications	2014
NFPA 1051: Standard for Wildland Fire Fighter Professional Qualifications	2012
NFPA 1401: Recommended Practice for Fire Service Training Reports and Records	2012
NFPA 1403: Standard on Live Fire Training Evolutions	2012
NFPA 1404: Standard for Fire Service Respiratory Protection Training	2013
NFPA 1500: Standard on Fire Department Occupational Safety and Health Program	2013
NFPA 1581: Standard on Fire Department Infection Control Program	2015
NFPA 1584: Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises	2015
NFPA 1720: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Volunteer Fire Departments	2014
NFPA 1851: Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting	2014
NFPA 1852: Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)	2013