RESEARCH

United States Firefighter Injury Report 2018

Richard Campbell, Ben Evarts and Joseph L. Molis

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Key Findings

An estimated 58,250 firefighter injuries occurred in the line of duty in 2018, a decrease of one percent from the 2017 injury total.

In addition to injuries, the report estimates that firefighters experienced 6,175 exposures to infectious diseases and 47,150 exposures to hazardous substances.

Firefighters were more likely to be injured at fireground operations than at other types of duties. In 2018, 22,975 injuries—39 percent of all reported firefighter injuries—occurred at the fireground.

The leading cause of fireground injuries was overexertion or strain (28 percent).

Strain, sprain, or muscular pain injuries accounted for nearly two out of every five (38 percent) injuries on the fireground.

Other major fireground injuries involved smoke or gas inhalation (13 percent); wounds, cuts, bleeding, or bruising (11 percent); and thermal stress, such as frostbite or heat exhaustion (10 percent).

Non-fireground injuries included 4,150 injuries while responding to or returning from an incident; 8,175 injuries incurred during training activities; 11,625 injuries at non-fire emergency incidents; and 11,325 injuries during other on-duty activities.

Strains, sprains, and muscular pain accounted for 59 percent of all non-fireground injuries.

In 2018, an estimated 14,425 collisions involved fire department emergency vehicles responding to or returning from incidents.

Background and Objectives

Firefighters work in varied and complex environments that expose them to a number of potential hazards. Each year, the NFPA studies firefighter deaths and injuries to provide national statistics on their frequency, extent, and characteristics. Earlier this year, the NFPA reported that there were 64 firefighter fatalities while on duty in 2018 (See NFPA's report, *Firefighter Fatalities in the United States – 2018*).[1] Having a better understanding of how firefighters become injured or ill on the job can help inform intervention efforts that help ensure firefighter safety and health.

This report examines 2018 firefighter injuries in the United States. The results are based on data collected during the NFPA Survey of Fire Departments for US Fire Experience (2018). An earlier report, *Fire Loss in the United States During 2018*,[2] measured the national fire experience in terms of the number of fires that fire departments responded to and the resulting civilian deaths, civilian injuries, and property losses that occurred.

This year's report includes the following among its results:

- An estimate of the total number of 2018 firefighter injuries
- An estimate of the number of injuries by type of duty
- An estimate of the number of exposures to infectious diseases
- Trends in firefighter injuries and rates
- Fireground injuries by cause
- Fire department vehicle accidents and the resulting firefighter injuries
- Descriptions of selected incidents that illustrate firefighter safety issues

[1] Rita F. Fahy, et al, *Firefighter Fatalities in the US – 2018* (Quincy, MA: National Fire Protection Association, 2019).
[2] Ben Evarts, "Fire Loss in the United States During 2018," *NFPA Journal* (Quincy, MA: National Fire Protection Association, September/October 2019) Vol. 113, No. 5.

Results

Based on data reported by fire departments responding to the 2018 National Fire Experience Survey, we estimate that 58,250 firefighter injuries[3] occurred in the line of duty in 2018. This is a decrease of one percent from the year before and the lowest number since NFPA began analyzing this data in 1981 (See Figure 1).

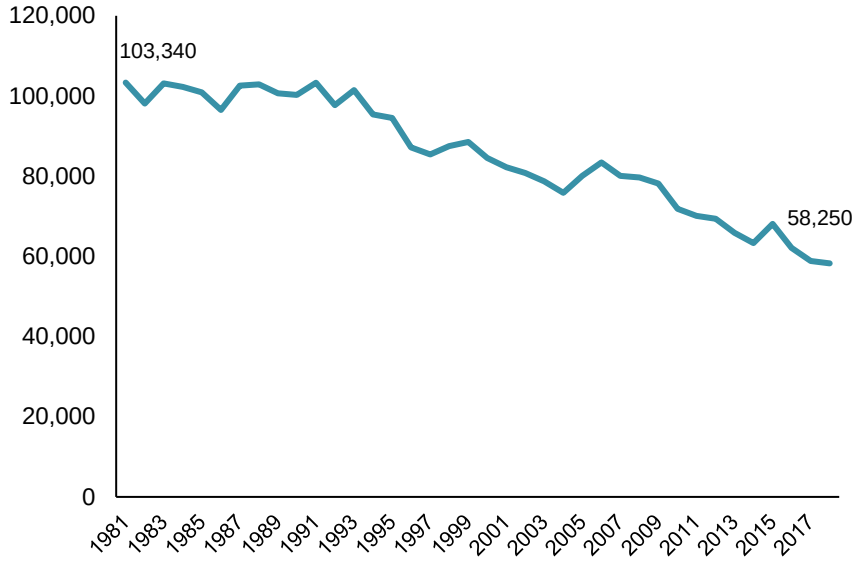
In recent years, the number of reported firefighter injuries has been considerably lower than in the 1980s and 1990s. This decrease is due in part to additional survey questions on exposure to hazardous conditions and infectious diseases—information that enables us to categorize them separately. Previously, these exposures might have been included in the total injuries in other categories.

NFPA estimates that there were 6,175 exposures to infectious diseases, such as hepatitis, meningitis, and HIV, in 2018. This amounts to 0.3 exposures per 1,000 emergency medical service runs by fire departments that year. We also estimate there were 47,150 exposures to hazardous substances, such as asbestos, radioactive materials, chemicals, and fumes in 2018.

The increase in exposures in recent years can be explained in part by the heightened awareness about cancer and other chronic illnesses in the fire service and the importance of documentation. This could also be a result of improved reporting of exposures. An estimated 15,500 injuries, or 27 percent of all firefighter injuries, resulted in lost time.

This report provides a high-level overview of firefighter injuries. See NFPA's 2016 report, *Patterns of Firefighter Fireground Injuries*, which uses data collected in the US Fire Administration's National Fire Incident Reporting System (NFIRS), for more information on these injuries.

Figure 1. Total firefighter injuries by year, 1981–2018



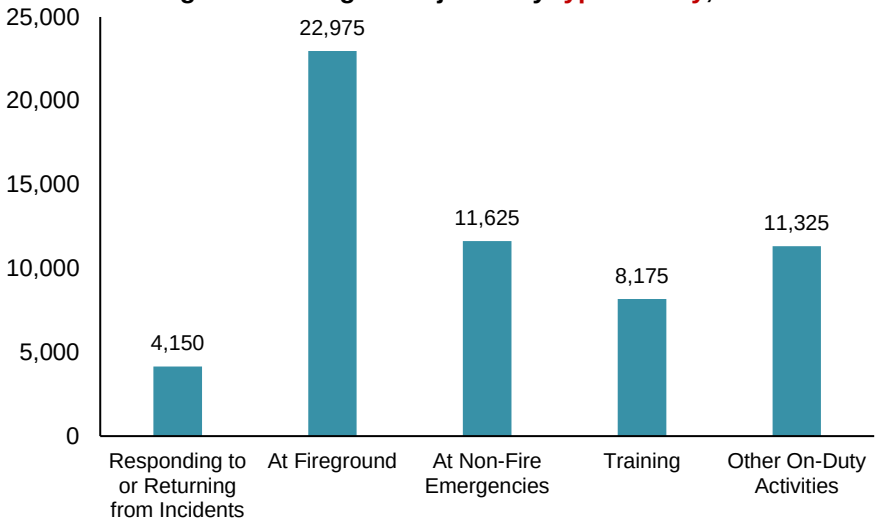
Injuries by Type of Duty

As in past reports, the type of duty associated with an injury is characterized using five distinct categories of work activity: responding to or returning from an incident (includes fire and non-fire emergencies); non-fire emergencies (includes rescue calls, hazardous calls, and natural disaster calls); training; other on-duty activities (e.g., inspection or maintenance duties), and fireground operations (includes structure fires, vehicle fires, brush fires, etc.).

Estimates of firefighter injuries by type of duty are displayed in Figure 2.

[3] With any estimate based on a sample survey, there is a confidence interval that measures the statistical certainty (or uncertainty) of the estimate. Based on data reported by fire departments responding to the NFPA Survey for US Fire Experience (2018), the NFPA is very confident that the actual number of firefighter injuries falls within the range of 55,250 to 61,250.

Figure 2. Firefighter injuries by type of duty, 2018



Firefighters were more likely to be injured at fireground operations than at other types of duties. In 2018, 22,975 injuries (39 percent of all firefighter injuries) occurred at the fireground, a six percent decrease over 2017 (Table 1). Injuries at the fireground in 2018 represented a 66 percent decline from the 67,500 injuries in 1981 (Figure 3). The number of fires also declined steadily for an overall decrease of 54 percent.

The rate of injuries per 1,000 fires over the past 35 years has fluctuated between a high of 28.3 injuries per 1,000 fires in 1990 to a low of 17.4 injuries per 1,000 fires in 2018 (Table 1). This decline in injury rates offers strong evidence that efforts for injury prevention have been effective, even if additional work remains to be done.

The number of injuries at non-fire emergencies increased by 21 percent between 1981 and 2018, from 9,600 to 11,625. During this same period, the number of non-fire emergencies increased by 360 percent, influenced in large part by an increase in the number of medical emergencies to which fire departments responded. In general, the total number of injuries in non-fire emergencies has shown substantial fluctuation.

However, there has been a downward trend in these injuries since 2008, so it is worth following whether this trend continues in future years. It is also important to note that the injury rate per 1,000 non-fire emergencies declined between 1981 and 2018, from 1.2 to 0.3, largely because the number of non-fire emergencies increased at a higher rate than the number of injuries at non-fire responses, as shown in Table 1.

Figure 3. Fireground injuries by year, 1981–2018

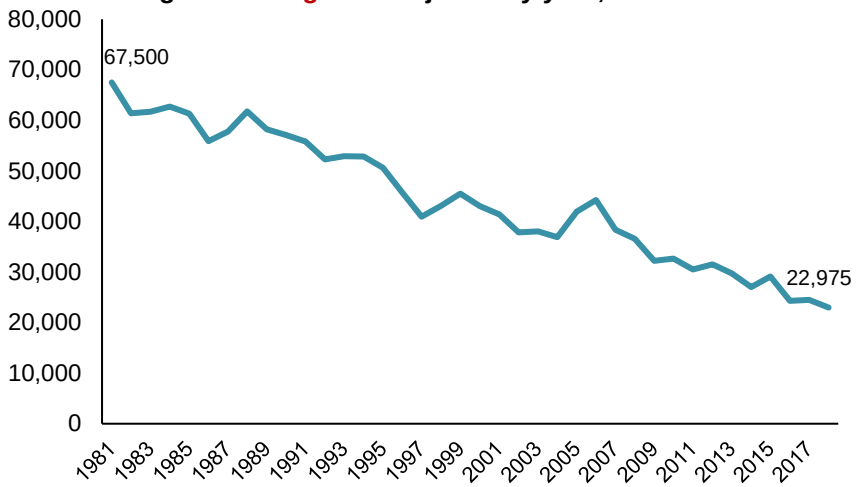
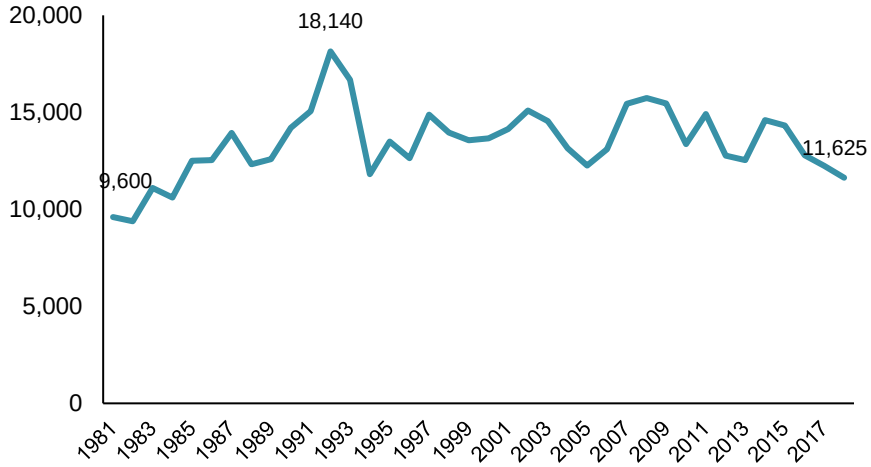


Figure 4. Injuries at non-fire emergencies, 1981–2018



Another 8,175 firefighter injuries occurred during training activities, and 11,325 injuries occurred during other on-duty activities. In addition, 4,150 firefighter injuries occurred while responding to or returning from an incident in 2018.

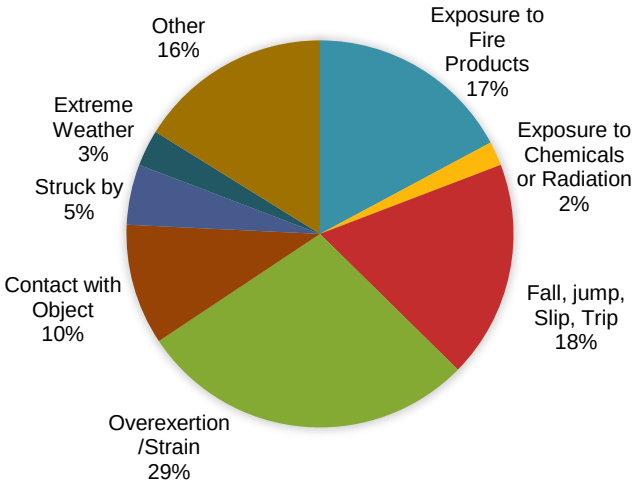
Nature and Causes of Fireground Injuries

The major types of injuries that occurred during fireground operations were strains and sprains, which accounted for 38 percent of the injuries; smoke or gas inhalation, which accounted for 13 percent; wounds, cuts, bleeding, and bruising, which accounted for 11 percent; and thermal stress, such as frostbite or heat exhaustion, with 10 percent.

Strains, sprains, and muscular pain were the leading types of injury in all firefighter activities and accounted for 59 percent of all non-fireground injuries, while wounds, cuts, bleeding, and bruising were the second leading cause of injury in non-fireground activities, accounting for 16 percent. See Table 2.

As the major location of firefighter injuries, injuries on the fireground are of particular concern, and the major causes of fireground injuries are shown in Figure 5 by cause, defined here as the initial circumstance leading to the injury. Overexertion/strain was the leading cause of fireground injuries, which accounted for three in 10 injuries. Other major causes were falls, jumps, or slips and exposure to fire products, each accounting for slightly less than one in five injuries.

Figure 5. Fireground injuries by cause, 2018



Fire Department Vehicle Collisions

A previous NFPA report (*Firefighter Fatalities in the United States — 2018*) stated that 16 firefighters died in vehicle-related incidents in 2018; 12 were fatally injured in vehicle collisions, three were struck by vehicles at incident scenes, and one fell from the rear seat of a moving apparatus.

In 2018, an estimated 14,425 collisions involved fire department vehicles responding to or returning from incidents. Fire departments responded to 36.7 million incidents in 2018, meaning that the number of collisions represents 0.04 percent of the total responses.

However, these collisions resulted in 575 injuries, or one percent of all firefighter injuries. Another 700 collisions involved personal vehicles when firefighters were responding to or returning from incidents. These collisions resulted in an estimated 50 injuries (Table 3).

Vehicle Safety

Investigations of vehicle-related firefighter fatalities by the National Institute for Occupational Safety and Health (NIOSH) have identified several key contributing factors to injury incidents during transport, including failure to use seatbelts, excess speed for conditions, and the need for vehicle maintenance. Firefighters may also be exposed to vehicle hazards when not in transit, particularly when in or near roadways where hazards may be influenced by lighting, road conditions, time of day, and the speed and volume of traffic.

Safety protocols and training programs based on best practices can help to reduce firefighter injuries from a variety of vehicle-related hazards. At a basic level, this entails mandatory seatbelt use for all firefighters in all areas of the vehicle or apparatus – including personal vehicles used during response.

Firefighters should also receive training in such areas as operating vehicles at safe speeds, navigating intersections, and backing up an apparatus. To prevent injuries to firefighters working near roadways, NIOSH has developed safe procedure recommendations for such areas as parking and staging sites and for the personal safety of firefighters working near traffic.

Average Number of Fires and Fireground Injuries per Department by Population Protected

The number of fires to which a fire department responds is relative to the population it protects. The number of fireground injuries in a department is also relative to the number of fires to which the department responds. This point is demonstrated by the average number of fireground injuries per year per fire department, which ranges from a high of 82.4 for departments that protect communities of 500,000 or more, to a low of 0.2 for departments that protect communities of fewer than 5,000 people (Table A).

One way to understand the risk of firefighter injury is to examine the number of fireground injuries per every 100 fires. This considers relative fire experience and allows for a more direct comparison between departments protecting communities of different sizes.

In 2018, the overall range of injury rates varied from 2.5 injuries per 100 fires for departments that protected communities with populations of 500,000 or more to 1.2 injuries per 100 fires for departments that protected communities with populations between 100,000 and 249,999.

Table A. Average Number of Fires, Fireground Injuries and Injury Rates by Population of Protected Community, 2018

Population of Community	Average Number of Fireground Injuries	Fireground Injuries per 100 Fires	Fireground Injuries per 100 Firefighters
500,000 or more*	82.4	2.5	5.6
250,000 to 499,999	23.0	1.8	4.3
100,000 to 249,999	6.8	1.2	2.8
50,000 to 99,999	3.8	1.7	3.3
25,000 to 49,999	2.2	1.9	3.4
10,000 to 24,999	0.8	1.3	2.0
5,000 to 9,999	0.5	1.3	1.5
2,500 to 4,999	0.3	1.3	1.2
Under 2,500	0.2	1.5	0.9

*Excludes New York City. Source: NFPA Survey of Fire Departments for US Fire Experience, 2018.

Larger fire departments generally had the highest rates of fireground injuries per firefighter; departments protecting communities of 500,000 or more experienced 5.6 injuries per 100 firefighters. As the size of the community decreases, the rate of fireground injuries generally declines; in this case, the rate dropped to a low of 0.9 for departments protecting fewer than 2,500 residents. That represents a difference in risk of injury per firefighter of 6 to 1 between communities of 500,000 or more people and communities of fewer than 2,500 residents.

Firefighters in larger cities may experience higher injury risks due to the presence of infrastructure and large buildings that can expose them to more complicated hazards than firefighters in areas with less developed infrastructure and smaller buildings.

In addition, larger departments respond to 281 times as many fires as the smaller departments. Larger departments also incur considerably more fireground injuries, even though departments protecting communities with populations of 500,000 on average have more than 74 times as many firefighters as departments protecting populations smaller than 2,500. Different policies for documenting minor injuries and different levels of fire engagement could also explain some of the difference.

Discussion

Since 1981, when firefighter injury data was first collected for this report, the annual number of reported firefighter injuries has generally followed a downward trend. While this decline is encouraging, our findings indicate that firefighter injury and illness—in excess of 58,000 injuries in 2018—continue to represent a substantial problem, not only for firefighters and their families, but also for the cities and towns that bear a financial burden for the various expenses related to injury and illness.

As the statistics in this report and previous reports attest, firefighting presents the risk of personal injury to firefighters. Due to the kind of work they perform and the hazards of the incident scene environment, it is unlikely that all firefighter injuries can be eliminated. However, the adoption of proactive safety programs can help to reduce injury and illness among fire departments and other emergency response personnel.

As an example, the prevalence of strain and sprain injuries identified in this report has been well documented in other research and has been the focus of numerous prevention initiatives. Although many of the activities that influence strain injuries are a regular part of firefighting—such as carrying hoses and heavy equipment, performing forcible entry, climbing ladders, and contending with uneven and slippery surfaces—injury prevention specialists have identified potential opportunities to reduce injury risk.

For instance, training in techniques to reduce the mechanical load on parts of the musculoskeletal system involved in ergonomically challenging tasks, such as bending and lifting, has been shown to reduce injuries to the back and upper extremities in firefighters.[4] Better aerobic fitness has also been found to be associated with a lower risk of firefighter sprain and strain injuries, underscoring a need for structured fitness programs in firefighter injury prevention efforts.[5]

Research indicates that firefighters may fail to follow model injury prevention practices because they are unaware of new protocols, have limited training, or don't have access to new equipment, which the authors argue could be mitigated through the adoption of proactive risk management programs. The underutilization of patient transfer equipment to reduce strain and sprain injuries is an indication of the need for greater attention to injury control through comprehensive risk management.[6]

Safety protocols and training programs based on best practices can help to reduce firefighter injuries caused by the variety of the hazards they experience. A recent study of the NIOSH firefighter fatality database found that personal protective equipment, seatbelt use, and fitness were contributing factors in nearly half of the fatalities between 2009 and 2014.[7]

The researchers also found that a lack of training or experience and inappropriate medical clearance were factors in fire departments that did not have standard operating protocols for respirator fitness testing, the use of personal protective equipment, fitness testing, rapid intervention, medical clearance, safety or distress alarms, vehicle maintenance, or incident command. An absence of key safety protocols was seen to put firefighters at risk, which the authors suggested might be increasing over time.

In addition to efforts to prevent traumatic injuries, it is also critically important for firefighter health and safety programs to develop policies and procedures that address other health risks of firefighting activities, including prevention efforts around behavioral health, cardiovascular health, and protection from exposure to toxic materials.

Annual medical evaluations are an important component of programs meant to reduce the risk of cardiac events, and they should include clearance for duty by physicians who are familiar with the physical demands of firefighting. Fitness and wellness programs also play a role in enhancing the ability of firefighters to contend with the cardiovascular strain of fire-related duties. At the fireground, good practice requires on-scene rehabilitation to ensure adequate hydration and rest, as well as medical monitoring to evaluate indications of cardiovascular strain.

Besides reducing the risk of injury, firefighter health and safety programs need to focus on reducing exposure to contaminants or pathogens that might lead to illness or disease, whether through inhalation, ingestion, or absorption through the skin. Firefighters are exposed to a variety of contaminants at the fire scene—and potentially at the fire station itself in the case of diesel exhaust—that might be carcinogenic. However, while carcinogens represent a particularly serious health threat for firefighters, they are also at risk for chronic respiratory disease, coronary heart disease, and other illnesses from their work-related exposures.

The use of SCBA gear with properly fitting masks is essential for work when exposure to contaminants is an issue, including during overhaul when contaminants are less obvious but still present. Suppression activities also require the use of gloves and hoods to protect against dermal absorption of hazardous substances. Although the hazards of firefighting are very real, the use of best practice health and safety protocols, active

[4] Peate, W.F., Bates, G, et al., "Core strength: A new model for injury prediction and prevention." *Journal of Occupational Medicine and Toxicology* 11 (2007): 2–3.
[5] Poplin, G.S., Roe, D.J., et al., "The association of aerobic fitness with injuries in the fire service." *American Journal of Epidemiology* 179 (2014): 149–155.
[6] Pollack, K.M., Poplin, G.S., et al., "Implementing risk management to reduce injuries in the U.S. fire service." *Journal of Safety Research* 60 (2017): 21–27.
[7] Kahn, S.A., Palmieri, T.L., et al., "Factors implicated in safety-related firefighter fatalities." *Journal of Burn Care & Research* 38 (2016).

training programs, and other measures can help protect firefighters in all areas of work activity.

Contaminated Gear and Equipment

In recent years, cancer concerns have prompted considerable interest in minimizing firefighter exposure to toxic contaminants. Among the areas of emerging interest is attention to the health hazards of contaminated gear and equipment. Some of the best practices relating to avoiding exposure to dirty gear are likely to be beyond the reach of many fire departments, including such practices as purchasing two sets of gear for every firefighter or spatially separating clean and dirty zones of fire stations in ways that require substantial station redesign.

However, there are a number of best practices that are not expensive and can be implemented right away, such as removing gear before returning to the station and storing it in leak-proof bags or using alternate footwear inside the station. Information on best practices for reducing exposure to carcinogens is available from the Washington State Council of Firefighters.

NFPA Annual Fire Department Survey Research Methods

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 and includes all the United States fire departments that protect communities with a population larger than 5,000 residents. These 8,854 fire departments protect a population of 279 million people, or 85 percent of the United States population as of July 2018. The rest of the sample includes 14,338 randomly selected departments that protect populations under 5,000 residents, for a total sample size of 23,192, or 78 percent of all the departments known to NFPA in the United States.

A ratio estimation was used for the survey, with stratification by community size[8]. For each injury statistic, a sample injury rate was computed for each stratum. This rate consisted of the total for that particular statistic from all the departments reporting it, divided by the total population protected by the departments reporting the statistic. Note that this means the departments used in calculating each statistic could be different and could reflect differences in unreported statistics. The national projections were made by weighting the sample results according to the proportion of the total US population of communities of each size. There is a confidence interval that measures statistical certainty for any estimate based on a sample survey. We are confident that the actual number of total firefighter injuries falls within five percent of the estimate.

Data was collected by sending designated fire departments a form requesting descriptions of the circumstances that led to injuries. A total of 2,631 departments responded to the 2018 fire experience survey. The results reported here are based on the injuries incurred by public fire departments. No state or federal firefighting entities are included in and no adjustments were made for injuries that occurred during fires attended to solely by private fire brigades.

Special Section: Select 2018 US Firefighter Injury Incidents

Trapped beneath debris in partial structural collapse

A firefighter was injured in a partial structural collapse while fighting a residential fire.

On a frigid night, with the ground covered in deep snow, the local fire department received 911 calls at approximately 3 a.m. reporting a fire in an occupied home. Arriving crews encountered a well-advanced, wind-driven fire that was already spreading to adjacent structures. The fire was consuming three multiple-family dwellings, each built of wooden balloon-frame construction, and the dwellings were as close as 10 feet (3 meters) apart. Firefighters were challenged by the bitter cold, deep snowbanks, and an advanced fire with an occupant reported missing and still inside the burning building.

The first-in company officer immediately requested additional resources to control the escalating fire. Seven firefighters—an engine company with three firefighters and a heavy rescue with four firefighters—were

[8] William G. Cochran, *Sampling Techniques*, John Wiley, New York, NY 1977, pp. 150–161.

assigned to enter one of the adjacent exposure structures and to extinguish the fire in the attic. On their way to the attic, the firefighters performed extinguishment and overhaul on the second floor. Two firefighters from the heavy rescue crew were inside the second-floor kitchen as a member of the engine company operated a handline with his lieutenant several feet away on a landing. The other firefighters from both companies were in the stairway making their way up to the second floor, advancing the hose line up the stairs.

As the fire conditions in the attic worsened, the incident commander ordered an immediate building evacuation. Twenty seconds after the evacuation order, the chimney and roof structure collapsed and crashed down into the second floor, trapping one of the heavy rescue firefighters in the kitchen.

The trapped firefighter, a 51-year-old with 30 years of service, was pinned beneath a roof joist and other roofing materials. He immediately attempted to call a mayday, but the transmit button on his portable radio had been smashed and would not operate. He called for his heavy rescue partner who had stepped out of the room moments before the collapse. The partner heard the pleas for help and immediately called a mayday.

The trapped firefighter and his partner began assessing the situation. The victim was not only trapped with the end of the smoldering roof joist pinning the back of his left knee and calf, but there was fire above and below him. The members of the engine company immediately directed their hose line onto the victim and began extinguishing the fire surrounding him.

The incident commander immediately acknowledged the mayday and activated the rapid intervention team (RIT), which consisted of an engine company staffed with an officer and three firefighters and a ladder company staffed with an officer and two firefighters. The on-scene safety chief immediately went to the rear stair and directed the rescue operations from the second-floor landing. All fireground radio communication was assigned to a separate radio frequency and rescue operations remained on the original fireground radio channel.

The firefighters in the collapse area quickly reached the victim and began developing a rescue plan to remove him from the rubble. The victim was pinned in a sitting position, was conscious and alert, and was able to provide some assistance to his rescuers. With the fire extinguished around him, firefighters worked with their hands and available tools to free him and crews outside the building shuttled equipment to the work area. After several minutes, the RIT team had joined the other members in the rescue attempt. Approximately 16 minutes after the mayday was declared, the RIT team performed a full facepiece swap with the victim. Crews used battery-operated spreaders to create a gap large enough to pull his leg out from under the roof debris. The victim walked out of the building under his own power to a waiting advanced life support ambulance. The mayday was cleared and all the firefighters were accounted for 33 minutes after the mayday was called.

The victim was wearing a complete protective ensemble. He was treated and released from the hospital the following morning, only to return several days later with complications and infection of the burn area. He followed up with a burn clinic and ultimately had a skin graft performed. He returned to full firefighting activities five months after the injury, but he attended physical therapy for nearly a year.

The mayday called by the victim's partner proved to be a critical communication that provided everyone on the scene with an accurate description of what happened, who was trapped, the victim's location, and what was needed. During the rescue, the victim was provided with air and water, two essential elements of RIT team operations.

The fire department indicated during its near-miss review that several experienced firefighters were exhibiting signs of critical incident stress during the interviews. The panel immediately ceased the interviews and contacted the employee assistance program to provide services for the firefighters.

Burned in structure fire

A firefighter who was not wearing all of his protective clothing suffered burns while fighting a residential fire.

The fire department responded to a late afternoon fire in a single-family, wood-frame, ranch-style home constructed in the early 1970s. Arriving crews found fire venting out several bedroom windows.

The chief was the first to arrive and immediately established command. The occupants waiting outside reported that everyone was out of the

house. The first engine company arrived on the scene and initiated an aggressive interior attack by advancing a hose line through the attached garage into the living room. Once the crew was near the kitchen, they charged their hose line and began advancing down the hallway.

With a 27-year-old firefighter leading the hose line down the dark hallway, the engine company could see that the bedroom had already flashed over and fire was beginning to roll over their heads. They began applying water to the flames. An officer, who was right behind the firefighter leading the hose, could hear windows breaking as horizontal ventilation was performed by firefighters outside. Investigators later determined that the fire originated in a bedroom and was reported as under investigation. The home did not have working smoke alarms.

During the fire attack, the officer heard the nozzle firefighter say that he thought he had been burned. Approximately 30 to 60 seconds after the second handline approached, the main body of fire was knocked down and the two firefighters abandoned their handline and exited the building.

The nozzle firefighter suffered second-degree burns to his ears and neck. The chief requested that an ambulance respond and the burned firefighter was transported to the closest emergency room. He was treated at the burn clinic and returned to firefighting activities nearly two months after the incident.

The injured firefighter, with nearly two years of service, was not wearing a hood, though he was wearing the rest of his protective ensemble in accordance with departmental procedures. The chief stated that due to the violation of department policy, the officer and firefighter were disciplined and arrangements were made for additional training on the use of protective clothing for the department.

Struck by fire apparatus on icy bridge

A paramedic and a firefighter were injured as they attempted to avoid a fire department apparatus that had lost control on an icy road.

The fire department received several calls during an ice storm regarding a motor vehicle crash, possibly with entrapment. Two units were dispatched: an ambulance staffed with a firefighter and a paramedic and a tower ladder staffed with the assistant chief and two firefighters.

The medic unit arrived first and began assessing the scene. The crash was on a frozen bridge; the surrounding roadways had not been treated and were extremely slippery. As the tower ladder approached the scene, it began to slide on the ice. The truck started turning to the left and responders on the scene recognized that it was heading directly toward them. Three police officers scattered, while the paramedic jumped off the bridge, falling approximately 20 feet (6 meters) into an icy stream. The firefighter tried to escape but slipped and fell on the ice and the tower ladder drove over him as he lay in the road. The front tires passed over him completely, with one of the rear tires driving over his legs. The tower ladder slid approximately 40 to 100 feet (12–30 meters) before crashing into the bridge. All of the members were seated in approved riding positions and wearing seatbelts and were not injured.

The paramedic who jumped from the bridge suffered a severe foot injury that required surgery. He was able to return to duty five to six months after the incident. The firefighter who was run over by the truck suffered only contusions and returned to duty a month later.

Following the incident, the department prioritized the mental health of its members both on the scene and within the department. It immediately activated a regional peer support program to deal with critical incident stress, and it was made available to every member of the department. The members who had been on the scene attended a minimum of three counseling sessions. The department stated it was adamant about protecting its members' emotional health, as well as treating their physical injuries.

There was approximately $35,000 worth of damage to the tower ladder, which was repaired.

Three wildland firefighters injured in burn over

Two inmate firefighters and a wildland firefighter suffered severe burns while operating at a rapidly escalating wildland fire.

Eight hours into the fire, it was determined that the weather conditions were favorable for crews to begin firing operations by burning fuels approximately a quarter-mile (.4 km) south of the fire. During the operation, the wind shifted direction, causing rapid fire growth due to

sustained northeasterly winds of 25 mph (40 kph) and blocking the firefighters' escape routes.

One of the inmate firefighters attempted to run through the advancing flames into the burned area, forgetting about the presence of a barbed-wire fence. He was burned when he became entangled in the fence, but he was able to extricate himself, find an opening in the fence, and escape into the burned area.

The second inmate firefighter ran toward the emergency vehicles and attempted to jump over the barbed-wire fence. He was able to clear the fence, but his hand tool caught on the fence, causing him to fall to the ground. He landed face-first on the ground and the fast-moving flames ignited his hair and facial hair. It is unclear how the third firefighter was burned as he was caught in the burn over.

Another crew leader operating nearby witnessed the incident and attempted to call in a request for ambulances, but he had difficulty doing so due to heavy radio traffic. He was eventually able to get through. He brought all three injured firefighters together and requested that several advanced life support units respond to their location. Approximately 45 minutes after the fire event, all three firefighters were transported to the emergency room, where they were treated for burn injuries to their faces and necks.

Bulldozer rollover in wildfire incident

A bulldozer operator suffered minor injuries in a rollover during firefighting activities.

A team leader and two bulldozer operators were assigned to build a fire line approximately three miles (4.8 km) from a wildland fire. The proposed line was reviewed by the leader, who felt it could be done safely. He used glow sticks to identify rock outcroppings, performed a safety briefing, and communicated objectives with the two bulldozer operators.

Bulldozer 1 was assigned to the lead position with Bulldozer 2 trailing behind to widen the fire line. The team leader was approximately 100–150 feet (30–46 meters) in front of Bulldozer 1, acting as a guide. Once they encountered the first rock outcropping, the operator of Bulldozer 1 exited his vehicle and met with the leader to review the operation. After navigating the obstacle and resuming operations, they continued building the fire line for several hundred feet.

The leader maintained communication with the operators, informing them of the changing conditions. When he looked back up the ridge to check on the operation, he saw Bulldozer 1 tilt approximately 45 degrees, then suddenly rotate 90 degrees as the front of the machine lifted into the air. The bulldozer slid and rolled over, landing upright approximately 300 feet (91 meters) downhill.

The operator of Bulldozer 1 had four years of bulldozer experience and extensive knowledge of the machinery having used it at multiple wildland fires. He was able to extricate himself but suffered a head laceration and contusions to his face. He was transported to the emergency room by helicopter and advanced life support ambulance. He was treated and released 16 hours after the incident.

Vehicle crash while responding to fire

A 19-year-old firefighter with two years of experience in the fire department was injured in a crash while responding to a building fire.

The fire department was dispatched to a report of smoke coming from a single-family home, indicating a possible fire. The firefighter responded from his home in his personal vehicle with his emergency lights activated. He lost control of his car on a curve on a two-lane road, approximately 1 mile (1.6 km) from his home. The car then skidded onto the shoulder and the passenger-side rear door struck a telephone pole.

The driver, who was wearing his seatbelt, suffered minor injuries, including whiplash and some bruising. He returned to full firefighting activities three weeks after the crash.

NFPA Codes and Standards References

NFPA identifies a number of protocols and initiatives that can be used at the local level to promote the safety and health of personnel.

- Get top fire service management committed to reducing injuries. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 4.3.*
- Establish a safety committee headed by a safety officer to recommend a safety policy and the means of implementing it. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 4.5.*
- Develop and implement an investigation procedure that includes all accidents, near misses, injuries, fatalities, occupational illnesses, and exposures involving members. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 4.4.4. and Section 4.4.5.*
- Provision the appropriate protective equipment and the rules for using it. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 7.1 through Section 7.8.*
- Develop and enforce a program on the use and maintenance of SCBA. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 7.9 through Section 7.14.*
- Develop and enforce policies on safe practices for drivers and passengers in a fire apparatus. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 6.2 and Section 6.3.*
- Develop procedures to ensure the response of sufficient personnel for both firefighting and overhaul duties. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 4.1.2; NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments;* and *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.*
- Implement regular medical examinations and a physical fitness program. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 10.1 through Section 10.3; NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments; and NFPA 1583, Standard on Health-Related Fitness Programs for Fire Department Members.*
- Adopt and implement an incident management system. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Section 8.1* and *NFPA 1561, Standard on Emergency Services Incident Management System and Command Safety.*
- Train and educate all the members of emergency operations. *NFPA 1500™, Standard on Fire Department Occupational Safety, Health, and Wellness Program, Chapter 5.*
- Implement programs for the installation of private fire protection systems so that fires are discovered earlier, exposing firefighters to less hostile environments. *NFPA 1, Fire Code* and *NFPA 101®, Life Safety Code®*
- Increase efforts in the area of fire safety education so citizens are aware of measures to prevent fires and of the correct reactions to fire situations. *NFPA 1201, Standard for Providing Fire and Emergency Services to the Public, Chapter 6.*

Other NFPA standards that may help in reducing firefighter injuries and illnesses include:

- NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.
- *NFPA 1584, Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises*, 2008 Edition, Chapter 4 Preparedness and Chapter 6 Incident Scene and Training Rehabilitation.
- *NFPA 1002, Standard for Fire Apparatus Driver/Operator Professional Qualifications*, 2010 Edition, Section 4.8 The Risk Management Process. *NFPA 1620, Standard for Pre-Incident Planning*,2010 Edition, Chapter 4 Pre-Incident Planning Process, Chapter 5 Physical & Site Considerations, Chapter 7 Water Supplies & Fire Protection Systems, and Chapter 8 Special Hazards.

Efforts need to be made to recognize that the number of firefighter injuries can be reduced. By addressing the priorities listed above, fire service organizations can make significant strides toward reducing the number and impact of such injuries.

Definition of Terms

Fire: Any instance of uncontrolled burning. Excludes combustion explosions and fires out on arrival (whether authorized or not); overpressure ruptures without combustion; mutual aid responses; smoke scares; and hazardous materials responses, e.g., flammable gas, liquid, or chemical spills without fire.

Incident: The movement of a piece or pieces of fire service apparatus or equipment in response to an alarm.

Injury: Physical damage suffered by a person that requires (or should require) treatment by a practitioner of medicine (physician, nurse, paramedic, or EMT) within one year of the incident (regardless of whether treatment was actually received), or that results in at least one day of restricted activity immediately following the incident.

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To learn more about the research, visit nfpa.org/research.
Email: research@nfpa.org

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Table 1.
Total Firefighter Injuries, Firefighter Injuries at the Fireground, and Firefighter Injuries at Non-Fire Emergencies, 1981–2018

Year	Total Firefighter Injuries	Firefighter Injuries at the Fireground		Firefighter Injuries at Non-Fire Emergencies	
		Injuries	Injuries per 1,000 Fires	Injuries	Injuries per 1,000 Incidents
1981	103,340	67,500	23.3	9,600	1.2
1982	98,150	61,400	24.2	9,385	1.2
1983	103,150	61,700	26.5	11,105	1.3
1984	102,300	62,700	26.8	10,600	1.2
1985	100,900	61,300	25.9	12,500	1.4
1986	96,540	55,900	24.7	12,545	1.3
1987	102,600	57,755	24.8	13,940	1.4
1988	102,900	61,790	25.4	12,325	1.1
1989	100,700	58,250	27.5	12,580	1.1
1990	100,300	57,100	28.3	14,200	1.3
1991	103,300	55,839	27.3	15,065	1.2
1992	97,700	52,290	26.6	18,140	1.4
1993	101,500	52,885	27.1	16,675	1.3
1994	95,400	52,875	25.7	11,810	0.8
1995	94,500	50,640	25.8	13,500	0.9
1996	87,150	45,725	23.1	12,630	0.8
1997	85,400	40,920	22.8	14,880	0.9
1998	87,500	43,080	24.5	13,960	0.8
1999	88,500	45,500	25.0	13,565	0.8
2000	84,550	43,065	25.2	13,660	0.7
2001	82,250	41,395	23.9	14,140	0.7
2002	80,800	37,860	22.4	15,095	0.8

Table 1.
Total Firefighter Injuries, Firefighter Injuries at the Fireground, and Firefighter Injuries at Non-Fire Emergencies, 1981–2018
(Continued)

Year	Total Firefighter Injuries	Firefighter Injuries at the Fireground		Firefighter Injuries at Non-Fire Emergencies	
		Injuries	Injuries per 1,000 Fires	Injuries	Injuries per 1,000 Incidents
2003	78,750	38,045	24.0	14,550	0.7
2004	75,840	36,880	22.1	13,150	0.6
2005	80,100	41,950	26.2	12,250	0.6
2006	83,400	44,210	26.9	13,090	0.6
2007	80,100	38,340	24.6	15,435	0.7
2008	79,700	36,595	25.2	15,745	0.7
2009	78,150	32,205	24.1	15,455	0.6
2010	71,875	32,675	24.5	13,355	0.5
2011	70,090	30,505	22.0	14,905	0.5
2012	69,400	31,490	22.9	12,760	0.4
2013	65,880	29,760	24.0	12,535	0.4
2014	63,350	27,015	20.8	14,595	0.5
2015	68,085	29,130	21.6	14,320	0.4
2016	62,085	24,325	18.1	12,780	0.4
2017	58,835	24,495	18.6	12,240	0.4
2018	58,250	22,975	17.4	11,625	0.3

Source: NFPA Survey of Fire Departments for US Fire Experience (1981–2018).

Table 2. Firefighter Injuries by Nature of Injury and Type of Duty, 2018

Nature of Injury	Responding to or Returning from Incidents		Fireground		Non-Fire Emergency		Training		Other Duties		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Burns (fire or chemical)	50	(1%)	1,175	(5%)	50	(0%)	125	(2%)	150	(1%)	1,550	(3%)
Smoke or gas inhalation	75	(2%)	2,950	(13%)	75	(1%)	0	(0%)	50	(0%)	3,150	(5%)
Other respiratory distress	100	(2%)	525	(2%)	100	(1%)	100	(1%)	150	(1%)	975	(2%)
Burns and smoke inhalation	0	(0%)	1,150	(5%)	125	(1%)	75	(1%)	100	(1%)	1,450	(2%)
Wounds, cuts, bleeding, or bruising	800	(19%)	2,575	(11%)	1,700	(15%)	1,200	(15%)	1,800	(16%)	8,075	(14%)
Dislocation, fracture	150	(4%)	600	(3%)	75	(1%)	300	(4%)	175	(2%)	1,300	(2%)
Heart attack or stroke	50	(1%)	300	(1%)	75	(1%)	100	(1%)	300	(3%)	825	(1%)
Strain, sprain, or muscular pain	2,350	(57%)	8,725	(38%)	6,850	(59%)	5,200	(64%)	6,425	(57%)	29,550	(51%)
Thermal stress (frostbite, heat exhaustion)	125	(3%)	2,200	(10%)	125	(1%)	325	(4%)	100	(1%)	2,875	(5%)
Other	450	(11%)	2,775	(12%)	2,450	(21%)	750	(9%)	2,075	(18%)	8,500	(15%)
Total	4,150	(100%)	22,975	(100%)	11,625	(100%)	8,175	(100%)	11,325	(100%)	58,250	(100%)

Note: In cases where individual firefighters sustained multiple injuries, only the nature of the most serious injury was tabulated and reported.

Source: NFPA Survey of Fire Departments for US Fire Experience During 2018.

Table 3. Fire Department Vehicle Collisions and Resulting Firefighter Injuries While Responding to or Returning from Incidents, 1990–2018

Year	Involving Fire Department Emergency Vehicles		Involving Firefighters' Personal Vehicles	
	Collisions	Firefighter Injuries	Collisions	Firefighter Injuries
1990	11,325	1,300	950	175
1991	12,125	1,075	1,375	125
1992	11,500	1,050	1,575	150
1993	12,250	900	1,675	200
1994	13,755	1,035	1,610	285
1995	14,670	950	1,690	190
1996	14,200	910	1,400	240
1997	14,950	1,350	1,300	180
1998	14,650	1,050	1,350	315
1999	15,450	875	1,080	90
2000	15,300	990	1,160	170
2001	14,900	960	1,325	140
2002	15,550	1,040	1,030	210
2003	15,900	850	980	85
2004	15,420	980	1,150	220
2005	15,885	1,120	1,080	125
2006	16,020	1,250	1,070	210
2007	14,650	915	665	120
2008	14,950	670	1,000	70
2009	15,100	820	870	100
2010	14,200	775	1,000	75
2011	14,850	970	790	190

Table 3. Fire Department Vehicle Collisions and Resulting Firefighter Injuries While Responding to or Returning from Incidents, 1990–2018 (Continued)

Year	Involving Fire Department Emergency Vehicles		Involving Firefighters' Personal Vehicles	
	Collisions	Firefighter Injuries	Collisions	Firefighter Injuries
2012	14,300	725	750	70
2013	12,350	730	830	185
2014	14,910	550	620	90
2015	16,600	1,150	700	50
2016	15,430	700	850	175
2017	15,425	1,005	795	75
2018	14,425	575	700	50

Source: NFPA Survey of Fire Departments for US Fire Experience (1980–-2018).