



RESEARCH

Physical Disability as a Factor in Home Fire Deaths

June 2014

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**PHYSICAL DISABILITY
AS A FACTOR IN HOME FIRE DEATHS**

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June 2014



**National Fire Protection Association
Fire Analysis and Research Division**

Abstract

NFPA estimates that physical disability was a factor in an average of 400, or 15%, of home fire deaths per year in 2007-2011. Half of the victims were involved in ignition and in the area of origin when the fire started. When physical disability contributed to the fatal injury, the victims were more likely to have been unable to act or to have been killed by a fire started by smoking materials than were home fire victims in general. More than half (55%) of the victims died in fires in which a smoke alarm operated.

These estimates are based on data from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey.

Keywords: fire statistics, home fires, physical disability, residential fires

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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Executive Summary

According to the U.S. Census Bureau's American Community Survey, in 2008-2012, 7% of the people at least five years of age living in the community had some type of ambulatory disability, defined as "having serious difficulty walking or climbing stairs." Such disability can delay or prevent an individual from escaping a fire.

NFPA estimates that physical disability was identified as a contributing factor in an estimated average of 400, or 15%, of U.S. home fire deaths per year during 2007-2011.

Providing adequate fire safety for individuals with physical disabilities can be challenging, particularly in cases of severe mobility limitations. Detection requirements consider the time a typical person needs to leave the building. If an individual cannot move out of danger, a working smoke alarm provides less benefit. In rare cases, particularly when an individual is already in poor health and in the immediate area of the fire origin, fatal injury may occur before a sprinkler operates.

In most cases, however, sprinklers reduce the intensity of the fire and the danger even when an individual cannot fully evacuate. In 2012, *NFPA Journal* writer Kenneth Tremblay described a Florida fire in which an operating sprinkler saved the life of a 50-year-old woman who used a wheelchair in a 13-story apartment building primarily for older adults. The woman's discarded cigarette ignited her sofa and spread to the adjacent paneling. A single sprinkler controlled the fire until firefighters could extinguish it completely. While the woman suffered severe burns, she did survive.

In this analysis, national estimates derived from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and NFPA's annual fire department experience survey are used to show the causes and circumstances of home fire deaths of victims when physical disability was a factor and highlight differences from overall home fire deaths. The [NFIRS Complete Reference Guide](#) notes that "physically disabled" includes temporary conditions, but it does not indicate if sensory disabilities should be included. Although the overall numbers may not capture disabilities that were not obvious, this information can help people with disabilities and those who work with or care for them to develop and communicate ways to better protect this community from fire.

Compared to all home fire victims, victims with physical disabilities were more likely to be female and at least 65 years of age. Fifty-one percent of these victims were female. Fifty-six percent of all home fire victims were male. When physical disability was a factor, three of every five (60%) victims were at least 65 years old compared to 30% of all home fire fatalities.

While home fire deaths in general are much more common between midnight and 6:00 a.m., time patterns were less pronounced when physical disability was a factor

More than half (55%) of these deaths resulted from home fires with operating smoke alarms compared to only 40% of home fire deaths overall.

When physical disability was a factor, half (52%) of the victims were involved in ignition and in the area of origin at the time the incident began. Including those who were not involved in ignition, almost two-thirds (65%) were in the area of origin when the fire started. More than one-quarter (29%) of the victims were unable to act to save themselves. Fifty-seven percent of the victims suffered both burns and smoke inhalation as their primary apparent symptom.

One-third (34%) of these victims died as a result of fires that started in a bedroom or sleeping area; one-quarter (24%) died from fires that began in the living room, family room, or den; and 13% from fires that started in the kitchen. Only one-quarter (25%) of home fire victims overall died from fires beginning in the bedroom or sleeping area. The percentages for the other leading areas were similar.

When physical disability was a factor, two of every five (42%) of the victims were killed by a fire started by smoking materials, compared to less than one-quarter (22%) of total home fire victims. Only 2% of the physical disability-related deaths resulted from intentionally set fires, compared to 13% of overall home fire victims.

Compared to overall home fire deaths, physical disability was a more common factor in deaths resulting from fires that began with either mattresses or bedding (20% of the deaths associated with physical disability vs. 13% overall), or clothing (8% of victims with physical disability contributing vs. 5% overall). Upholstered furniture was the leading item first ignited when physical disability was a factor (20%) and for all home fire deaths (18%).

Many people want to stay in the same home as they age. In fact, 85% of these victims died as a result of fires in one-or two-family homes. While age by itself does not cause disability, disability becomes more likely with increasing age. Plans should be made for a time when mobility might be impaired. Plans should also be made for short-term disability due to injury or illness that may limit movement.

With 29% of the victims unable to act after the fire started, and 52% involved in ignition and in the area of origin, it is clear that prevention is the best strategy. Mattresses and bedding, upholstered furniture, clothing, and other furnishings that are harder to ignite could be helpful.

According to a study by McClure et al. published in 2011 in *Archives of Physical Medicine and Rehabilitation*, 85% surveyed full-time wheelchair users with spinal cord injury felt they could evacuate their residence in an emergency, but only 64% had an actual evacuation plan. This suggests that more work is needed to ensure that people with disabilities have safe and realistic home escape plans.

***Emergency Evacuation Planning Guide* is available on NFPA's website.**

NFPA has safety information for and about people with disabilities at www.nfpa.org/disabilities. The *Emergency Evacuation Planning Guide* provides evacuation elements information (notification, way finding, use of the way, and assistance) and the five general categories of disability: (mobility, visual, hearing, speech and cognitive). A planning checklist is included.

The website also has [teaching tips for fire safety educators](#) who are working with children with disabilities and an [information sheet on workplace safety for people with disabilities](#). In addition, NFPA produces [e-ACCESS](#), a quarterly newsletter focusing on safety for people with disabilities. Architects, building managers and contractors may be interested in purchasing the [NFPA® Pocket Guide to the ADA & ABA](#) that requirements of the Americans with Disabilities act and the Architectural Barriers Act Accessibility Guidelines.

Additional steps must be taken to provide maximum safety for people with physical or sensory disabilities. This may be especially challenging for people living in one-or two family homes, the majority of fire victims. Many of the victims might have been saved had home fire sprinklers been present. While working and audible smoke alarms are essential, 55% of the victims with physical disabilities were fatally injured in fires with working smoke alarms. The 2013 edition of [NFPA 72, National Fire Alarm and Signaling Code](#), requires that audible notification appliances used in bedrooms for those with mild to severe hearing loss produce a low frequency signal. Another provision requires tactile notification appliances in addition to strobes for individuals with profound hearing loss. Improved notification, however, will only help those who can act.



Physical Disability as a Factor in Home Fire Deaths Fact Sheet

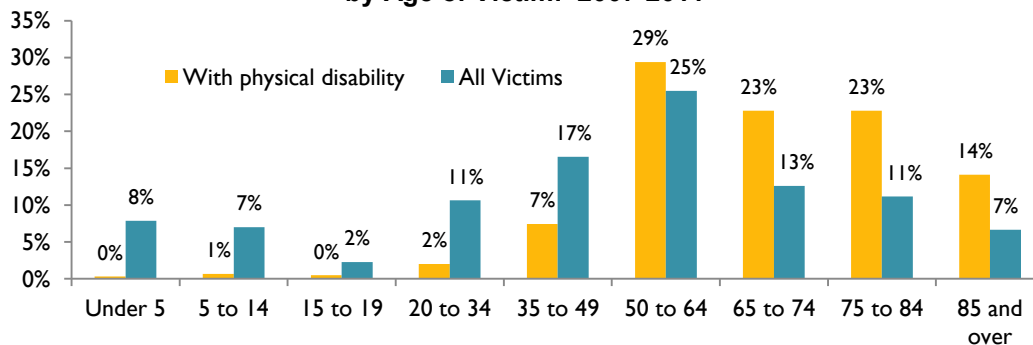
NFPA estimates that physical disability was a contributing factor in an estimated average of 400 (15%) home fire deaths per year. The American Community Survey found that 12% of community (non-institutionalized) residents in 2008-2012 had some type of disability. Seven percent of community residents five and over had serious difficulty walking or climbing stairs, as did one-quarter (24%) of community residents age 65 or older.

Causes and Circumstances of Home Fires Deaths With Physical Disability a Factor in 2007-2011

When physical disability* contributed to the fatal injury:

- More than half (55%) of the victims died as a result of home fires with working smoke alarms compared to only two out of five (40%) home fire victims overall.
- More than one-quarter (29%) of victims with physical disabilities were unable to act to save themselves compared to only 11% of home fire victims overall.
- Half (52%) of the victims were involved in ignition and were in the area of origin when the incident began compared to only two out of five (39%) of home fire victims overall.
- Victims were more likely to die from a fire that began with either mattresses or bedding (20% with a physical disability vs. 13% of all home fire victims), or clothing (8% vs. 5% of all home victims). One in five (20%) died in a fire that began with upholstered furniture compared to 18% of home fire victims overall.

Home Structure Fire Deaths with Physical Disability a Factor by Age of Victim: 2007-2011



- Three of every five victims (60%) when physical disability was a factor were at least 65 years old.
- Two of every five (42%) victims were killed by a fire started by smoking materials, compared to less than one-quarter (22%) of total home fire victims.
- 85% of the victims were killed in fires in one- or two-family homes. Apartment or multi-family housing fires killed 15% of the victims. This is consistent with overall home fire victims.

* Physical disability” may include temporary conditions but is not further defined.

Additional resources can be found at www.nfpa.org/disabilities.

Physical Disability as a Factor in Home Fire Deaths

Physical disability played a role in 15% of home fire deaths.

NFPA estimates that physical disability was a contributing factor in an annual average of 400, or 15%, of home fire deaths from 2007 to 2011. According to the U.S. Census Bureau's American Community Survey, in 2008-2012, 7% of the people at least five years of age living in the community had some type of ambulatory disability, defined as "having serious difficulty walking or climbing stairs." Such disability can delay or prevent an individual from escaping a fire.¹

The American Community Survey also found that 4% of the community population five years of age or older had difficulty hearing, 2% had problems with vision that could not be corrected with glasses, and 5% had cognitive difficulties. Codes from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS), the source of the detailed fire statistics in this analysis, do not specifically mention sensory disabilities as a code choice for a human factor contributing to injury. Vision and hearing impairments can cause a delay in awareness of fire and can make it difficult or impossible to read signs or hear directions. The [NFIRS Complete Reference Guide](#) notes that "physically disabled" includes temporary conditions, but it does not indicate if sensory disabilities should be included. It is unclear how often fire victims with sensory disabilities were coded as having a physical disability.

Incident descriptions illustrate some of the fire safety challenges.

Four fatal fires in which physical disabilities played a role and one in which a hearing impairment was a factor illustrate some of the challenges these conditions pose. The full articles and a collection of additional previously published descriptions of fatal fires in which a victim's disability played a role are included in Appendix C. While these anecdotes are not statistically representative, they provide more details about what can happen.

- A North Carolina dryer fire in a single-family home killed a 77-year-old woman, who was bedridden, and her 36-year-old granddaughter, who was unable to rescue her. The granddaughter called 911 to report the fire. Because the older woman could not move independently, the granddaughter dragged her into the hallway. When the fire got worse, she tried to protect her grandmother with her own body. Firefighters found both women in the hallway. The younger woman was already dead and the grandmother died later the same day.²
- A 92-year-old Virginia man who relied on a walker was fatally burned when his clothing ignited as he tried to turn off the kitchen range after a pan of cooking oil ignited. He attempted to put the fire out with water from the sink and another pan. A neighbor who heard his calls for help called 911.³
- A 55-year-old woman with a physical disability was fatally burned in a fire that started while she was smoking in bed. Sprinklers extinguished the fire, but the victim had

¹ U.S. Census Bureau. "[S1810. Disability Characteristics 2008-2012 American Community Survey 5-Year Estimates](#)"

² Kenneth J. Tremblay. "Firewatch: Dryer Fire Kills Two, North Carolina" *NFPA Journal*, 2008, May/June, 26-28.

³ Kenneth J. Tremblay, 2014, "Firewatch: Unattended Cooking Fire Kills Elderly Man, Virginia," *NFPA Journal*, January/February 31-32.

already been severely burned. Firefighters discovered the 350-pound (159-kilogram) woman on the burned mattress. Because they were unable to lift her with a special flexible stretcher, they used the mattress to drag her from the building. The victim reported that she was using a lighter to light a cigarette when a fan blew a napkin at her, and it caught fire. The burning napkin then ignited the bedding and her clothing. Flame damage was limited to the room of origin.⁴

- A 73-year-old woman who used a wheelchair and was blind was fatally burned when her clothing ignited after she dropped a burning foil-and-paper-wrapped sandwich from her microwave onto her lap. The fire self-extinguished before it grew large enough to activate the sprinklers. Investigators determined that the victim did not know the sandwich was wrapped in foil under the paper when she put it in the microwave. When the microwave was turned on, the arcing foil ignited the paper. Two other building occupants, ages 86 and 63, suffered smoke inhalation.⁵
- Although a smoke alarm operated, it did not alert a 100-year-old Nebraska woman who was not wearing her hearing aids to a fire involving the basement furnace in her single-family home. The woman died in the fire.⁶

This analysis examines how the causes and circumstances of fire deaths of people with physical disabilities differ from those of home fire deaths overall. This information is critical to providing a safer environment and appropriate messages for people who may not be able to respond as quickly or at all to an emergency situation.

Compared to all home fire victims, victims with physical disabilities were more likely to be female.

[Table 1](#) shows that when physical disability contributed to the fatal injury, 51% of the victims with physical disabilities were female. More than half (56%) of home fire victims overall were male.

When physical disability was a factor, victims had a similar likelihood to be fatally injured in a fire in a one- or two-family home as home fire victims overall (85% vs. 84%). See [Table 2](#).

Victims are more likely to be older when physical disability is a factor in home fire deaths.

[Figure 1](#) and [Table 3](#) show that three out of five (60%) victims with physical disability identified as a contributing factor in 2007-2011 were at least 65 years old, compared to 30% of all home fire victims. The American Community Survey, mentioned previously, found that the percentage of the population with a physical disability increased with age.

⁴ Kenneth J. Tremblay, 2011, "Firewatch: Smoking in bed leads to death, Kansas," *NFPA Journal*, January/February, 25-26.

⁵ Kenneth J. Tremblay, 2010, "Firewatch: Disabled Woman Dies in Cooking Fire, Pennsylvania," *NFPA Journal*, January/February, 24-25.

⁶ Kenneth J. Tremblay. "Firewatch: Smoke Kills 100-year-old Woman, Nebraska" *NFPA Journal*, 2008, September/October, 29.

Methodology

Statistics about home fire deaths were derived from NFIRS 5.0 and NFPA's fire department survey.

Unless otherwise specified, the statistics in this analysis are national estimates of fire deaths reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies. These estimates are projections based on the detailed information collected in Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association's (NFPA's) annual fire department experience survey.

"Homes" refer to one- and two-family homes, including manufactured homes, and multifamily dwellings, such as apartment buildings, row houses etc.

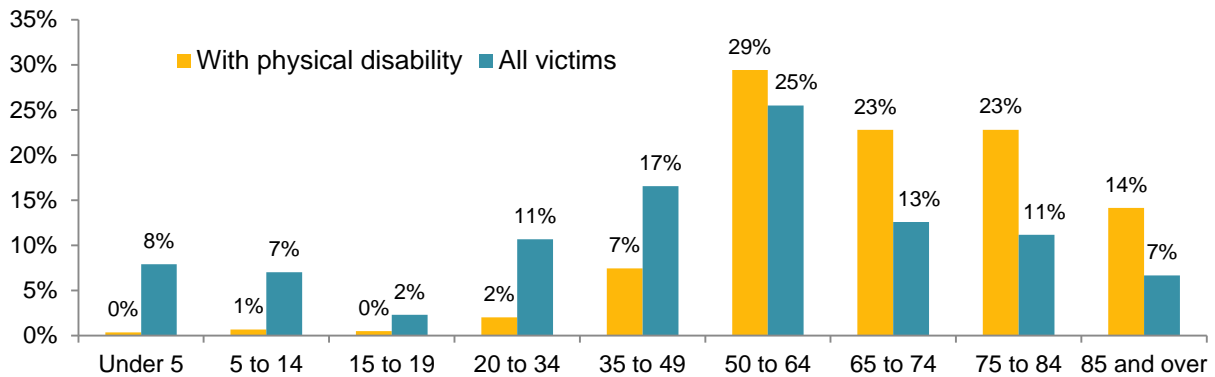
"Physically disabled" is one of the code choices in the field "human factors contributing to injury" in the NFIRS Civilian Casualty module. It includes temporary conditions. Because sensory disabilities are not specifically mentioned, it is unclear whether they would be captured here. Details on the methodology are provided in [Appendix A and B](#). Unless otherwise specified, fire statistics are annual averages for 2007-2011. "Physically disabled" was a factor in a total of 602 civilian deaths reported to NFIRS over the five-year period.

Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in calculations of national estimates. Fire deaths are rounded to the nearest ten. Sums may not equal totals due to rounding errors.

The phrase "*victims with physical disabilities*" is used throughout this report to describe victims of fires in which a physical disability contributed to the fatal injury. If a victim's disability was not a factor contributing to the fatal injury, the death is not included in these statistics.

In 2008-2012, 1% of the community residents ages 5-17 had most categories of disability, including difficulty walking or climbing stairs, difficulty hearing, and difficulty seeing, while 4% had a cognitive disability. Among those 18-64, 2% had difficulty hearing, 2% had difficulty seeing, 4% had cognitive issues, and 5% had problems walking or climbing stairs. Among those 65 or older, 7% had difficulty seeing. 15% had hearing problems, 9% had cognitive issues, and one-quarter (24%) had difficulty walking or climbing stairs. Thirteen percent of the people living in the community were at least 65 years old.

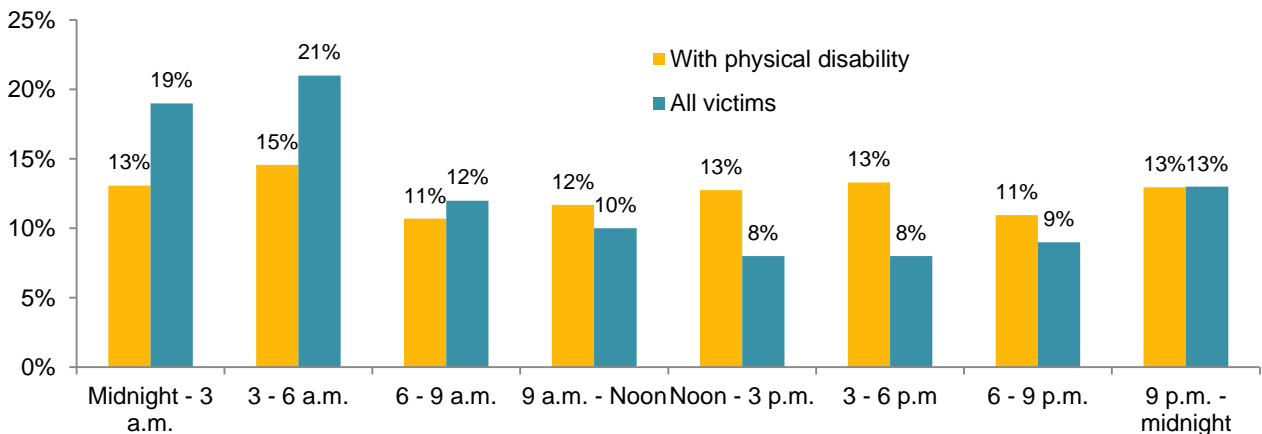
Figure 1.
Ages of Home Fire Victims with Physical Disability a Factor: 2007-2011



Alarm times for fatal fire victims with physical disabilities were spread more evenly through the day.

While overall home fire deaths are much more likely to result from fires reported between midnight and 6:00 a.m., Figure 2 and Table 4 show that when physical disability was a factor, the deaths resulted from fires spread fairly evenly throughout the day, with a peak of 15% from 3:00 - 6:00 a.m., and lows of 11% from 6:00 - 9:00 a.m. and 6:00 - 9:00 p.m.

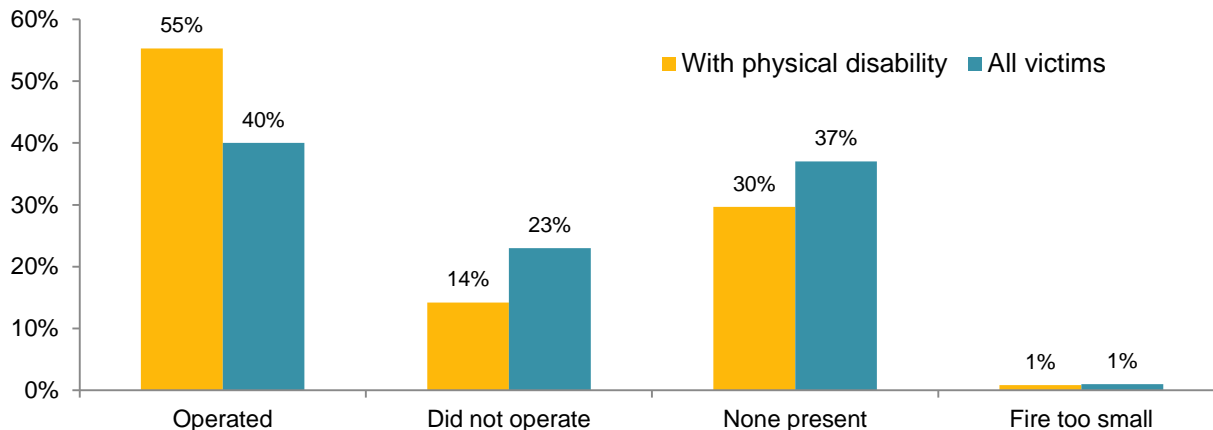
Figure 2.
Home Fire Victims with Physical Disability a Factor by Hour of Alarm: 2007-2011



More than half of the victims with physical disabilities were killed by fires in a home with working smoke alarms.

When physical disability was a factor, 70% of the home fire fatalities resulted from fires in homes with at least one smoke alarm. One or more smoke alarms were present in fires that caused 64% of all home fire deaths. Figure 3 and Table 5 show that 55% of the victims with a physical disability factor died as a result of fires with operating smoke alarms compared to 40% of total home fire victims. People with physical disabilities may be less able to respond quickly or at all to the early warning provided by smoke alarms. People with a hearing disability may not even hear a smoke alarm.

Figure 3.
Home Fire Victims with Physical Disability a Factor
by Smoke Alarm Status: 2007-2011



Two of every five victims with physical disabilities were killed by a fire started by smoking materials.

Figure 4 and Table 6 show that when physical disability was a factor, 42% of the deaths were caused by a fire started by smoking materials (i.e., lighted tobacco products but not matches or lighters), almost twice the 22% of total home fire deaths resulting from smoking materials. Cooking equipment was involved in 14% of the fire deaths of victims with physical disabilities, while heating equipment was involved in 12%. Victims with a physical disability were also much more likely to perish in fires that started with medical equipment (9% vs. 3% of victims overall), mostly due to medical oxygen. Only 2% of the victims with physical disabilities died as a result of intentionally set fires, compared to 13% of overall home fire victims.

Figure 4.
Home Fire Victims with Physical Disability a Factor
by Major Fire Causes: 2007-2011

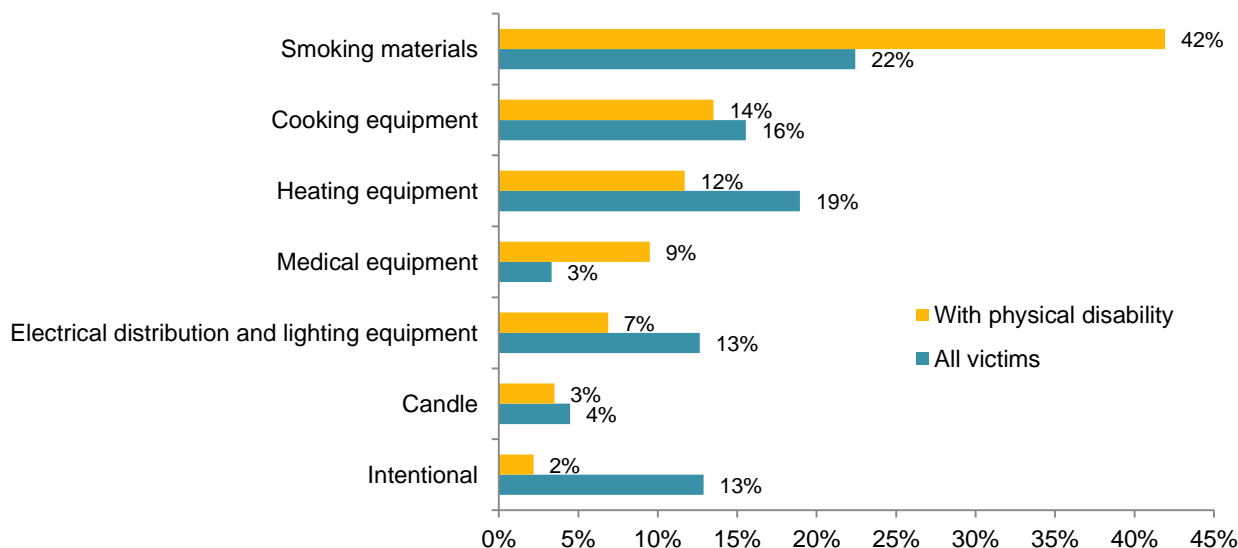


Figure 4 and Table 6 were derived from several different fields in NFIRS. When the causes come from different fields, they are not mutually exclusive. More detail is provided about

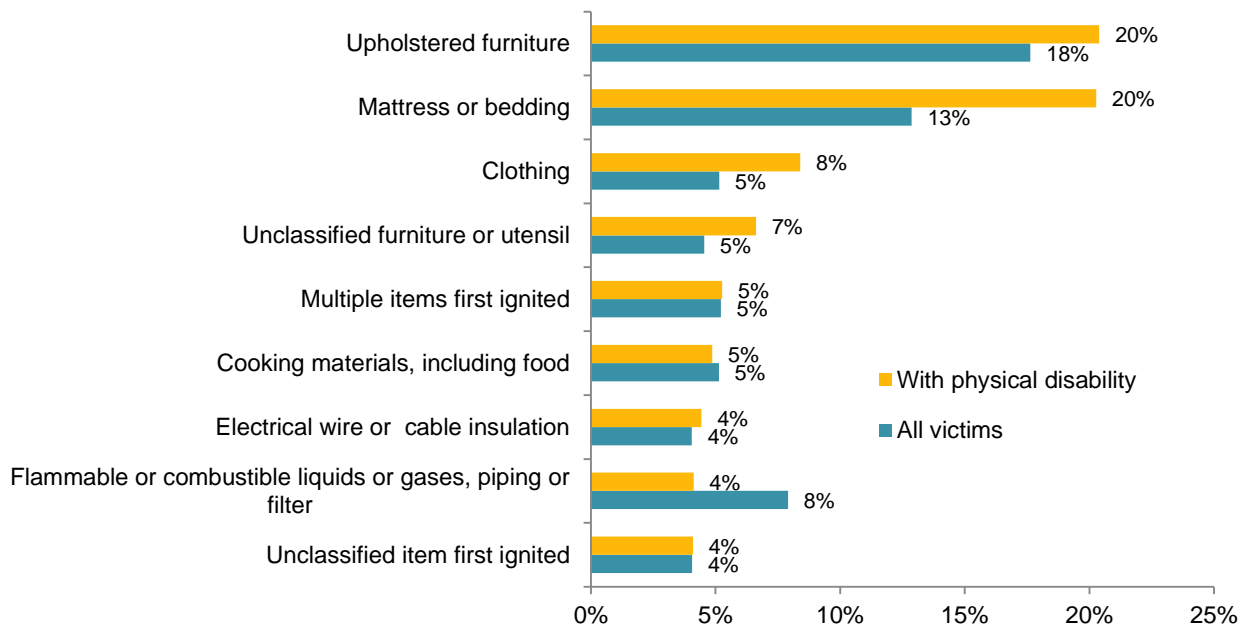
equipment involved in ignition in [Table 7](#), heat sources in [Table 8](#), and factor contributing to ignition in [Table 9](#).

When equipment was mentioned as the cause, it means the equipment provided the heat of ignition. [Table 7](#) shows that medical oxygen administration equipment was involved in 9% of these deaths. Smoking materials were the heat source in four-fifths (82%) of all home fire deaths involving medical oxygen,⁷ and in four-fifths (79%) of the home fire deaths of people in which oxygen administration equipment was involved and physical disability was a contributing factor. Fixed or portable space heaters were involved in 11% of the deaths associated with physical disability. [Table 9](#) shows that a heat source too close to something that could catch fire was a factor in one-quarter (26%) of the fire deaths in which physical disability played a role.

Compared to overall home fire deaths, victims with physical disabilities were more likely to die from a fire that began with either mattresses or bedding, or clothing.

Figure 5 shows that mattresses or bedding were the items first ignited in 20% of fatal home fire injuries in which physical disability was a contributing factor, almost double the 13% for home fire deaths overall. [Table 10](#) shows that upholstered furniture was first ignited in 20% of the deaths associated with physical disabilities, and clothing was first ignited in 8%. The percentage of these deaths from fires in which clothing was first ignited was almost twice as high as for home fire deaths overall (5%).

**Figure 5.
Home Fire Victims with Physical Disability a Factor
by Item First Ignited: 2007-2011**



⁷ John R. Hall, Jr. *The Smoking Material Fire Problem*, Quincy, MA: NFPA, 2013, p. 33.

One-third of the deaths associated with physical disability resulted from fires beginning in the bedroom.

Table 11 shows that when physical disability contributed to the fatality, 34% of the deaths resulted from fires that started in a bedroom; one-quarter (24%) from fires that began in the living room, family room, or den; and 13% from fires that started in the kitchen. Only one in four (25%) home fire victims overall died from fires beginning in the bedroom. The percentages for the other leading areas were similar.

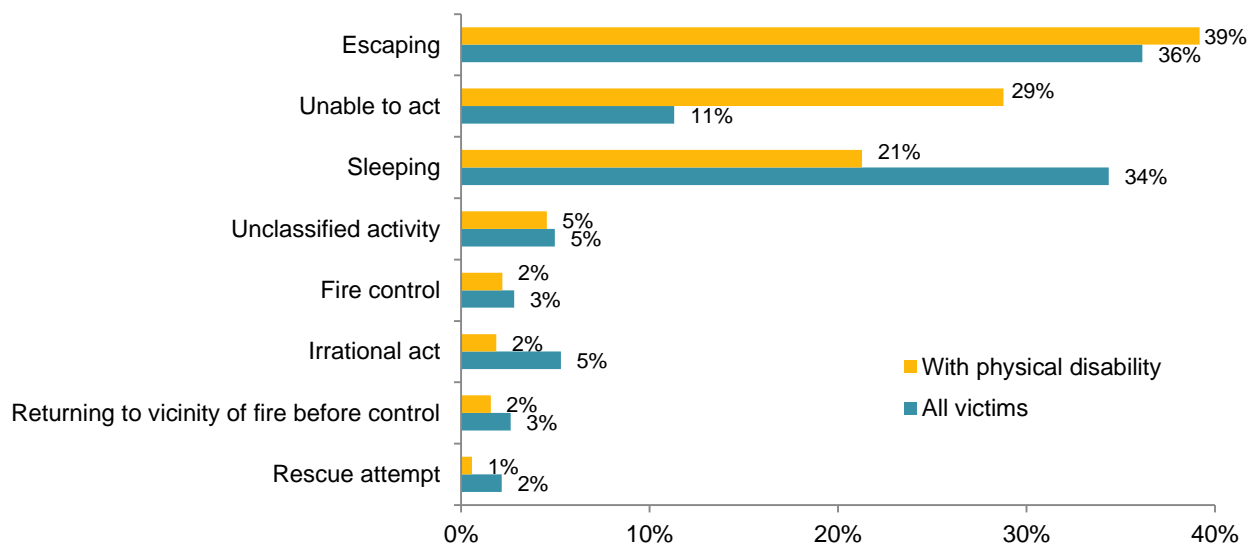
When physical disability was a factor, victims were more likely to have been in the fire area and involved in ignition.

Table 12 shows that when physical disability contributed to the death, half (52%) of the victims were in the area of origin at the time the incident began and involved in ignition. This was true for only 39% of home fire victims overall. Including those who were not involved in ignition, roughly two-thirds (65%) of the victims with a factor of physical disability were in the area of origin when the fire started compared to half (51%) of all home fire victims.

When physical disability contributed to the death, more than one-quarter of victims were unable to act to save themselves.

Table 13 shows that when physical disability was a contributing factor, 39% of those who died in home fires were fatally injured while trying to escape, a somewhat higher percentage than for home fire victims overall. Twenty-nine percent were unable to act. Figure 6 shows that only 11% of victims overall could not act. When physical disability was a factor, victims were much less likely to be sleeping when fatally injured (21%) than were home fire victims overall (34%).

Figure 6.
Home Fire Victims with Physical Disability a Factor
by Activity when Injured: 2007-2011

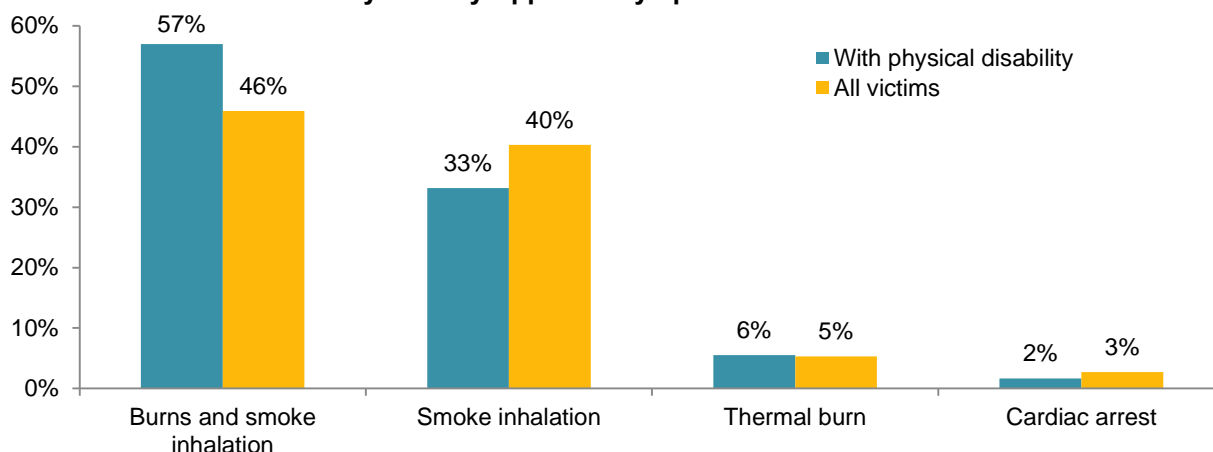


Victims with physical disabilities were more likely to suffer both burns and smoke inhalation.

Table 14 shows that, according to fire department reports, when physical disability was a factor contributing to the fatal injury, 57% of the home fire victims reportedly had suffered both burns

and smoke inhalation. Figure 7 shows that this was much higher than the 46% of all home fire victims with symptoms of both conditions. This is likely due to the higher percentage of victims with a physical disability who were in the same area as the fire origin than victims overall.

**Figure 7.
Home Fire Victims with Physical Disability a Factor
by Primary Apparent Symptom: 2007-2011**



Flame damage was somewhat less likely to have spread beyond the room of origin when physical disability was a factor.

Table 15 shows that when physical disability contributed to the fatal injury, 5% of the victims died from fires that were confined to the object of origin and 20% died from fires that spread beyond the first object but were confined to the room of origin. One-quarter (25%) of the victims with a physical disability died in a fire that was confined to the object or room of origin, compared to one-fifth (20%) of home fire victims overall. It is important to remember that some victims, particularly those in the area of origin, may be fatally injured before the fire has spread to its ultimate size.

Sleep and possible alcohol impairment were less common factors when physical disability was a factor.

Table 16 shows that sleep was a factor (as opposed to the victim’s activity) in 15% of the deaths of victims in which physical disability played a role. An unattended or unsupervised person was mentioned as a factor in 6% of the deaths. Only 6% were possibly impaired by alcohol. Compared to all home fire deaths, being asleep and alcohol impairment were much less common factors for victims with physical disability mentioned as a factor. However,

Fire Safety and People with Disabilities

***Emergency Evacuation Planning Guide* is available on NFPA’s website.**

A well-thought and practiced escape plan is an essential component of fire safety. If one exit is blocked, is another available? Would security measures pose a problem? This planning is even more important for people with disabilities and any caregivers that might be involved. Can the

individual get out of bed without assistance? Can one caregiver provide enough assistance? What devices might be helpful? Are the individual and caregivers comfortable using them? McClure et al. surveyed full-time wheelchair users with spinal cord injuries about evacuation readiness. Eighty-five percent felt they would be able to safely evacuate their home in the event of an emergency such as a fire. However, only 64% actually had a plan. Half (52%) of those with a home evacuation plan said the plan relied on assistance from other people, and one-quarter (27%) said their plan required additional assistive technology.⁸ The researchers also asked about workplace evacuation and evacuation from the community in the event of a natural disaster and whether their evacuation plans required assistance from other individuals or assistive technology.

NFPA has safety information for and about people with disabilities at www.nfpa.org/disabilities. The [Emergency Evacuation Planning Guide](#) provides evacuation elements information (notification, way finding, use of the way, and assistance) and the five general categories of disability: mobility, visual, hearing, speech and cognitive. A planning checklist is included.

The website also has [teaching tips for fire safety educators](#) who are working with children with disabilities and an [information sheet on workplace safety for people with disabilities](#). In addition, NFPA produces [e-ACCESS](#), a quarterly newsletter focusing on safety for people with disabilities. Architects, building managers and contractors may be interested in purchasing the [NFPA® Pocket Guide to the ADA & ABA](#) that requirements of the Americans with Disabilities act and the Architectural Barriers Act Accessibility Guidelines.

The Fire Protection and Research Foundation recently released [Fire Alarms and People with ASD: A Literature Summary](#) about sound and light sensitivities and some anecdotal information from first responder interactions with people diagnosed with Autism Spectrum Disorders. Author Paul Kashmanian noted that the scientific literature he found did not address the response to fire alarms by people with ASD.

Provisions in NFPA 72 address needs of individuals with hearing loss.

In a project for the Fire Protection Research Foundation, Dorothy Bruck and Ian Thomas studied the waking effectiveness of different types of alarm signals for adults who were hard of hearing.⁹ A loud low frequency square wave auditory signal was most effective in waking people with moderate to severe hearing loss. This signal performed better than bed or pillow shakers and strobe lights. Strobe lights, when used alone, were not effective in waking this population. The 2013 edition of [NFPA 72, National Fire Alarm and Signaling Code](#), requires that audible notification appliances used in bedrooms for those with mild to severe hearing loss produce a low frequency signal. Another provision requires tactile notification appliances in addition to strobes for individuals with profound hearing loss. These provisions will take effect immediately when the new code is adopted.

⁸ McClure, Laura, et al., "[Emergency Evacuation Readiness of Full-Time Wheelchair Users With Spinal Cord Injury](#)," *Archives of Physical Medicine and Rehabilitation*. 92 (2011) pp. 491-498.

⁹ Dorothy Bruck and Ian Thomas. [Optimizing Fire Alarm Notification for High Risk Groups Research Project: Waking Effectiveness of Alarms \(Auditory, Visual and Tactile\) for Adults Who Are Hard of Hearing](#). Quincy, MA: The Fire Protection Research Foundation, June 2007.

Home fire sprinklers increase the chances of surviving a fire.

Home sprinkler systems respond quickly to reduce the heat, flames, and smoke from a fire. They can control or contain the fire until help arrives. This is particularly important to people who have mobility difficulties. In 2012, Kenneth Tremblay described a Florida fire in which an operating sprinkler saved the life of a 50-year-old woman who used a wheelchair in a 13-story apartment building primarily for older adults. The woman's discarded cigarette ignited her sofa and spread to the adjacent paneling. A single sprinkler controlled the fire until firefighters could extinguish it completely. While the woman suffered severe burns, she did survive.¹⁰

Sprinklers greatly increase the chance of survival by limiting fire growth. In rare cases, individuals with severe mobility impairments who are intimate with ignition or in poor health before the fire may be fatally injured before a sprinkler is activated. More information about home fire sprinklers may be found at <http://www.firesprinklerinitiative.org/>.

¹⁰ Kenneth J. Tremblay, 2012, "Firewatch: Sprinkler Controls Sofa Fire, Florida," *NFPA Journal*, September/October 27-28.

Table 1.
Home Fire Victims with Physical Disability a Factor, by Gender
2007-2011 Annual Averages

Gender	Disability as a Factor		All Victims	
Male	190	(49%)	1,450	(56%)
Female	200	(51%)	1,130	(44%)
Total	400	(100%)	2,570	(100%)

Table 2.
Home Fire Victims with Physical Disability a Factor, by Occupancy
2007-2011 Annual Averages

Occupancy	Disability as a Factor		All Victims	
One- or two-family home	340	(85%)	2,160	(84%)
Apartment	60	(15%)	410	(16%)
Total	400	(100%)	2,570	(100%)

Table 3.
Home Fire Victims with Physical Disability a Factor, by Age Group
2007-2011 Annual Averages

Age Group	Disability as a Factor		All Victims	
Under 5	0	(0%)	200	(8%)
5 to 14	0	(1%)	180	(7%)
15 to 19	0	(0%)	60	(2%)
20 to 34	10	(2%)	270	(11%)
35 to 49	30	(7%)	430	(17%)
50 to 64	120	(29%)	660	(25%)
65 to 74	90	(23%)	320	(13%)
75 to 84	90	(23%)	290	(11%)
85 and over	60	(14%)	170	(7%)
Total	400	(100%)	2,570	(100%)
65 and over	240	(60%)	780	(30%)

Note: Deaths are rounded to the nearest 10. An entry of zero may mean zero or the average rounded to zero. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.
Source: NFIRS 5.0 and NFPA survey.

Table 4.
Home Fire Victims with Physical Disability a Factor, by Hour of Alarm
2007-2011 Annual Averages

Hour of Alarm	Disability as a Factor		All Victims	
Midnight- 12:59 a.m.	10	(3%)	150	(6%)
1:00-1:59 a.m.	20	(5%)	190	(7%)
2:00-2:59 a.m.	20	(5%)	160	(6%)
3:00-3:59 a.m.	20	(6%)	190	(7%)
4:00-4:59 a.m.	20	(6%)	200	(8%)
5:00-5:59 a.m.	10	(3%)	150	(6%)
6:00-6:59 a.m.	20	(4%)	130	(5%)
7:00-7:59 a.m.	10	(3%)	110	(4%)
8:00-8:59 a.m.	10	(3%)	80	(3%)
9:00-9:59 a.m.	20	(4%)	90	(4%)
10:00-10:59 a.m.	10	(3%)	80	(3%)
11:00-11:59 a.m.	20	(4%)	70	(3%)
Noon -12:59 p.m.	20	(5%)	70	(3%)
1:00-1:59 p.m.	10	(4%)	60	(2%)
2:00-2:59 p.m.	20	(4%)	70	(3%)
3:00-3:59 p.m.	20	(5%)	70	(3%)
4:00-4:59 p.m.	10	(4%)	60	(2%)
5:00-5:59 p.m.	20	(5%)	70	(3%)
6:00-6:59 p.m.	20	(4%)	70	(3%)
7:00-7:59 p.m.	10	(3%)	80	(3%)
8:00-8:59 p.m.	20	(4%)	80	(3%)
9:00-9:59 p.m.	20	(4%)	100	(4%)
10:00-10:59 p.m.	10	(3%)	120	(4%)
11:00-11:59 p.m.	20	(6%)	130	(5%)
Total	400	(100%)	2,570	(100%)
Average by hour	20	(4%)	110	(4%)

Note: Deaths are rounded to the nearest 10. An entry of zero may mean zero or the average rounded to zero. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 5.
Home Fire Victims with Physical Disability a Factor, by Smoke Alarm Status
2007-2011 Annual Averages

Smoke Alarm Status	Disability as a Factor		All Victims	
Operated	220	(55%)	1,020	(40%)
Did not operate	60	(14%)	590	(23%)
None present	120	(30%)	950	(37%)
Fire too small	0	(1%)	20	(1%)
Total	400	(100%)	2,570	(100%)

Table 6.
Home Fire Victims with Physical Disability a Factor, by Major Cause
2007-2011 Annual Averages

Major Cause	Disability as a Factor		All Victims	
Smoking materials	170	(42%)	580	(22%)
Cooking equipment	50	(14%)	400	(16%)
Heating equipment	50	(12%)	490	(19%)
Medical equipment	40	(9%)	90	(3%)
Electrical distribution and lighting equipment	30	(7%)	330	(13%)
Intentional	10	(2%)	330	(13%)
Candle	10	(3%)	120	(4%)

Table 6 summarizes findings from multiple fields, meaning that the same fire may be listed under multiple causes. The methodology used is described in Appendix B.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 7.
Home Fire Victims with Physical Disability a Factor
by Equipment Involved in Ignition
2007-2011 Annual Averages

Equipment Involved in Ignition	Disability as a Factor		All Victims	
No equipment involved in ignition	210	(52%)	1,080	(42%)
Cooking equipment	50	(14%)	400	(16%)
<i>Range or cooktop</i>	40	(11%)	340	(13%)
<i>Portable cooking or warming equipment</i>	10	(1%)	20	(1%)
Heating equipment	50	(12%)	490	(19%)
<i>Fixed or portable space heater</i>	40	(11%)	400	(15%)
Oxygen administration equipment	40	(9%)	80	(3%)
Electrical distribution and lighting equipment	30	(7%)	330	(13%)
<i>Cord or plug</i>	10	(3%)	100	(4%)
<i>Wiring and related equipment</i>	10	(3%)	160	(6%)
Electric blanket	10	(1%)	10	(0%)
Unclassified portable appliance designed to produce heat	10	(1%)	30	(1%)
Clothes dryer or washer	10	(1%)	30	(1%)
Other known equipment involved	10	(3%)	190	(8%)
Total	400	(100%)	2,570	(100%)

Fire deaths in which the equipment involved in ignition was unknown or not reported have been allocated proportionally among deaths with known equipment involved. Fire deaths in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Fires in which the equipment was partially unclassified (i.e., unclassified kitchen or cooking equipment, unclassified heating, cooling or air condition equipment, etc.) were allocated proportionally among fires that grouping (kitchen or cooking equipment; heating, cooling or air conditioning equipment, etc.).

Categories or subcategories are shown if they account for 1% of the total.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey

Table 8.
Home Fire Victims with Physical Disability a Factor, by Heat Source
2007-2011 Annual Averages

Heat Source	Disability as a Factor		All Victims	
Smoking materials	170	(42%)	580	(22%)
Radiated or conducted heat from operating equipment	40	(10%)	340	(13%)
Arcing	30	(8%)	320	(13%)
Unclassified heat from powered equipment	30	(7%)	220	(9%)
Hot ember or ash	30	(7%)	120	(5%)
Unclassified heat source	20	(6%)	190	(7%)
Spark, ember or flame from operating equipment	20	(4%)	130	(5%)
Unclassified hot or smoldering object	20	(4%)	120	(5%)
Candle	10	(3%)	120	(4%)
Lighter	10	(3%)	150	(6%)
Match	10	(1%)	80	(3%)
Other known heat source	20	(5%)	200	(8%)
Total	400	(100%)	2,570	(100%)

The statistics on matches, lighters, smoking materials and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 9.
Home Fire Victims with Physical Disability a Factor, by Factor Contributing to Ignition
2007-2011 Annual Averages

Factor Contributing to Ignition	Disability as a Factor		All Victims	
Heat source too close to combustible	100	(26%)	550	(21%)
Abandoned or discarded material or product	90	(23%)	400	(16%)
Unclassified misuse of material or product	80	(21%)	300	(12%)
Electrical failure or malfunction	60	(15%)	480	(18%)
Unclassified factor contributed to ignition	30	(7%)	310	(12%)
Equipment unattended	20	(4%)	190	(7%)
Unclassified mechanical failure or malfunction	10	(3%)	50	(2%)
Leak or break	10	(2%)	30	(1%)
Unclassified fire spread or control	10	(2%)	40	(2%)
Improper container or storage	10	(1%)	10	(0%)
Other known factor	30	(8%)	470	(18%)
Total	400	(100%)	2,570	(100%)
Total entries*	450	(112%)	2,820	(110%)

*Multiple entries are allowed resulting in sums greater than totals. Fire deaths in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 10.
Home Fire Victims with Physical Disability a Factor, by Item First Ignited
2007-2011 Annual Averages

Item First Ignited	Disability as a Factor		All Victims	
Upholstered furniture	80	(20%)	450	(18%)
Mattress or bedding	80	(20%)	330	(13%)
Clothing	30	(8%)	130	(5%)
Unclassified furniture or utensil	30	(7%)	120	(5%)
Multiple items first ignited	20	(5%)	130	(5%)
Cooking materials, including food	20	(5%)	130	(5%)
Electrical wire or cable insulation	20	(4%)	100	(4%)
Flammable or combustible liquids or gases, piping or filter	20	(4%)	200	(8%)
Unclassified item first ignited	20	(4%)	100	(4%)
Floor covering, rug, carpet or mat	10	(3%)	100	(4%)
Rubbish, trash or waste	10	(3%)	50	(2%)
Cabinetry	10	(3%)	50	(2%)
Unclassified soft goods or wearing apparel	10	(3%)	50	(2%)
Magazine, newspaper or writing paper	10	(2%)	60	(2%)
Other known item	40	(9%)	550	(21%)
Total	400	(100%)	2,570	(100%)

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 11.
Home Fire Victims with Physical Disability a Factor, by Area of Origin
2007-2011 Annual Averages

Area of Origin	Disability as a Factor		All Victims	
Bedroom	140	(34%)	640	(25%)
Living room, family room or den	90	(24%)	610	(24%)
Kitchen or cooking area	50	(13%)	400	(16%)
Unclassified function area	50	(12%)	260	(10%)
Exterior balcony or unenclosed porch	10	(2%)	50	(2%)
Unclassified area of origin	10	(1%)	50	(2%)
Laundry room or area	10	(1%)	30	(1%)
Bathroom	10	(1%)	30	(1%)
Wall assembly or concealed space	10	(1%)	30	(1%)
Other known area of origin	40	(10%)	470	(18%)
Total	400	(100%)	2,570	(100%)

* In Version 5.0 of NFIRS, type of material first ignited is not required when organic materials such as vegetation or food, or general items such as electrical wire, cable insulation, rubbish, waste, dust, etc. were first ignited.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 12.
Fatal Home Fire Victims with Physical Disability a Factor
by Victim's Location at Time of Incident
2007-2011 Annual Averages

Victim's Location at Time of Incident	Disability as a factor		All victims	
In area of origin and involved	210	(52%)	1,010	(39%)
In area of origin and not involved	50	(13%)	300	(12%)
Not in area of origin and not involved	80	(19%)	620	(24%)
Not in area of origin but involved	60	(15%)	620	(24%)
Unclassified	0	(0%)	20	(1%)
Total	400	(100%)	2,570	(100%)

Table 13.
Home Fire Victims with Physical Disability a Factor, by Activity when Injured
2007-2011 Annual Averages

Activity When Injured	Disability as a Factor		All Victims	
Escaping	160	(39%)	930	(36%)
Unable to act	110	(29%)	290	(11%)
Sleeping	80	(21%)	880	(34%)
Unclassified activity	20	(5%)	130	(5%)
Fire control	10	(2%)	70	(3%)
Irrational act	10	(2%)	140	(5%)
Returning to vicinity of fire before control	10	(2%)	70	(3%)
Rescue attempt	0	(1%)	60	(2%)
Returning to vicinity of fire after control	0	(0%)	10	(0%)
Total	400	(100%)	2,570	(100%)

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 14.
Home Fire Victims with Physical Disability a Factor, by Primary Apparent Symptom
2007-2011 Annual Averages

Primary Apparent Symptom	Disability as a Factor		All Victims	
Burns and smoke inhalation	230	(57%)	1,180	(46%)
Smoke inhalation	130	(33%)	1,040	(40%)
Thermal burn	20	(6%)	140	(5%)
Cardiac arrest	10	(2%)	70	(3%)
Other known symptom	10	(3%)	150	(6%)
Total	400	(100%)	2,570	(100%)

Table 15.
Home Fire Victims with Physical Disability a Factor, by Extent of Flame Damage
2007-2011 Annual Averages

Extent of Flame Damage	Disability as a Factor		All Victims	
Confined to object of origin	20	(5%)	120	(4%)
Confined to room of origin	80	(20%)	390	(15%)
Confined to floor of origin	50	(12%)	260	(10%)
Confined to building of origin	200	(51%)	1,450	(56%)
Extended beyond building of origin	50	(13%)	350	(14%)
Total	400	(100%)	2,570	(100%)

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Table 16.
Fatal Home Fire Victims with Physical Disability a Factor
by Other Human Factors Contributing to Fatal Injury
2007-2011 Annual Averages

Other Human Factors Contributed	Disability as a Factor		All Victims	
Physically disabled	400	(100%)	400	(15%)
Asleep	60	(15%)	720	(28%)
Unattended or unsupervised person	30	(6%)	110	(4%)
Possibly impaired by drug or chemical other than alcohol	20	(6%)	120	(5%)
Possibly impaired by alcohol	20	(5%)	290	(11%)
Possibly mentally disabled	20	(4%)	130	(5%)
Unconscious	10	(2%)	130	(5%)
Physically restrained	0	(0%)	30	(0%)
None	0	(0%)	1,030	(40%)
Total	400	(100%)	2,570	(100%)
Total factors*	550	(139%)	2,960	(114%)

*Multiple human factors contributing to injury may be entered. This table is based on the deaths in which physical disability was a factor and provides estimates the frequency of other factors mentioned in addition for the same deaths.

Note: Deaths are rounded to the nearest 10. Percentages are calculated prior to rounding. Sums may not equal totals due to rounding.

Source: NFIRS 5.0 and NFPA survey.

Appendix A.

How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit <http://www.nfirs.fema.gov/>. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

Methodology may change slightly from year to year.

NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.

Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4)

information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit <http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf>.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online at <http://www.nfpa.org/osds> or through NFPA's One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

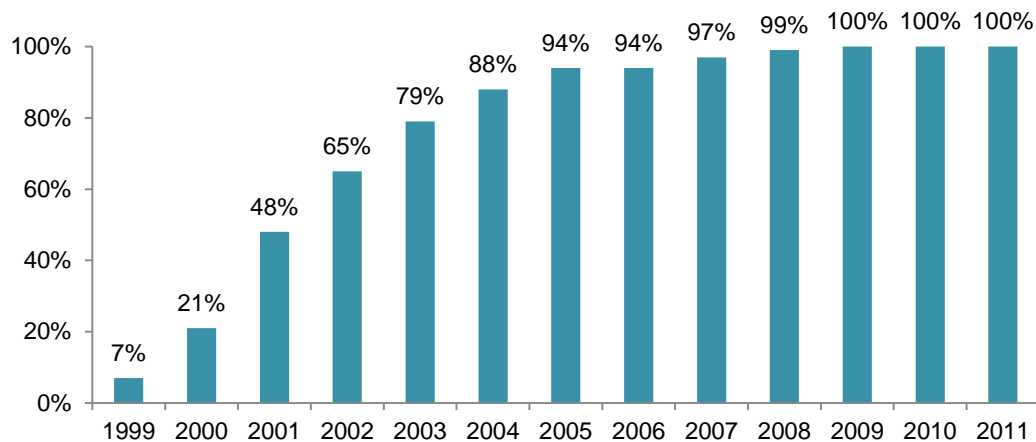
Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

$$\frac{\text{NFPA survey projections}}{\text{NFIRS totals (Version 5.0)}}$$

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year



NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Because this analysis focused on fatalities only, no distinction was made between confined and non-confined fires.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term “all fires” refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

In the formulas that follow, the term “all fires” refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Cause of Ignition: This field is used chiefly to identify intentional fires. “Unintentional” in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or “other” (unclassified).” The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown.

Factor Contributing to Ignition: In this field, the code “none” is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for “not reported” when no factors are recorded. “Not reported” is treated as an unknown, but the code “none” is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, “mechanical failure or malfunction.” This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;
27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in “electrical failure, malfunction” (factor contributing to ignition 30-39) may also be combined into one entry, “electrical failure or malfunction.” This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was

added to NFIRS 5.0, which is code 60: “Heat from open flame or smoking material, other.” NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
- 67 Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping “smoking materials” includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to “the piece of equipment that provided the principal heat source to cause ignition.” However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{(\text{All fires} - \text{blank} - \text{undetermined} - [\text{fires in which EII} = \text{NNN and heat source} \in \{40-99\}])}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

Code Grouping	EII Code	NFIRS definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Fixed wiring and related equipment	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	213	Electric meter or meter box
	214	Wiring from meter box to circuit breaker
	215	Panel board, switch board or circuit breaker board
	216	Electrical branch circuit
	217	Outlet or receptacle
	218	Wall switch
	219	Ground fault interrupter
Transformers and power supplies	221	Distribution-type transformer
	222	Overcurrent, disconnect equipment
	223	Low-voltage transformer
	224	Generator
	225	Inverter
	226	Uninterrupted power supply (UPS)
	227	Surge protector
	228	Battery charger or rectifier
	229	Battery (all types)

Code Grouping	EII Code	NFIRS definitions
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
	Cord or plug	260
261		Power cord or plug, detachable from appliance
262		Power cord or plug- permanently attached
263		Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
641	Breadmaking machine	

Equipment was not analyzed separately for confined fires. Instead, each confined fire incident type was listed with the equipment or as other known equipment.

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as “mattresses and bedding.” In many analyses, wearing apparel not on a person (code 34) and wearing apparel

on a person (code 35) are combined and shown as “clothing.” In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together.

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply “bedroom.” Chimney is no longer a valid area of origin code for non-confined fires.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

Appendix B. Methodology and Definitions Used in “Leading Cause” Tables

The cause table reflects relevant causal factors that accounted for at least 2% of the fires in a given occupancy. Only those causes that seemed to describe a scenario are included. Because the causal factors are taken from different fields, some double counting is possible. Percentages are calculated against the total number of structure fires, including both confined and non-confined fires. Bear in mind that every fire has at least three “causes” in the sense that it could have been prevented by changing behavior, heat source, or ignitability of first fuel, the last an aspect not reflected in any of the major cause categories. For example, several of the cause categories in this system refer to types of equipment (cooking, heating, electrical distribution and lighting, clothes dryers and washers, torches). However, the problem may be not with the equipment but with the way it is used. The details in national estimates are derived from the U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS). This methodology is based on the coding system used in Version 5.0 of NFIRS. The *NFIRS 5.0 Reference Guide*, containing all of the codes, can be downloaded from <http://www.nfirs.fema.gov/documentation/reference/>.

Cooking equipment and heating equipment are calculated by summing fires identified by equipment involved in ignition and relevant confined fires. Confined fires will be shown if they account for at least 2% of the incidents. **Confined cooking fires** (cooking fires involving the contents of a cooking vessel without fire extension beyond the vessel) are identified by NFIRS incident type 113.

Confined heating equipment fires include **confined chimney or flue fires** (incident type 114) and **confined fuel burner or boiler** fires (incident type 116). The latter includes delayed ignitions and incidents where flames caused no damage outside the fire box. The two types of confined heating fires may be combined or listed separately, depending on the numbers involved.

Intentional fires are identified by fires with a “1” (intentional) in the field “cause.” The estimate includes a proportional share of fires in which the cause was undetermined after investigation, under investigation, or not reported. All fires with intentional causes are included in this category regardless of the age of the person involved. Earlier versions of NFIRS included ignition factor codes for incendiary and suspicious. Intentional fires were deliberately set; they may or may not be incendiary in a legal sense. No age restriction is applied.

Fires caused by **playing with heat source** (typically matches or lighters) are identified by code 19 in the field “factor contributing to ignition.” Fires in which the factor contribution to ignition was undetermined (UU), entered as none (NN) or left blank are considered unknown and allocated proportionally. Because factor contributing to ignition is not required for intentional fires, the unknown share, by these definitions, is somewhat larger than it should be.

The heat source field is used to identify fires started by: **smoking materials** (cigarette, code 61; pipe or cigar, code 62; and heat from undetermined smoking material, code 63); **candles** (code 66), **lightning** (code 73); and **spontaneous combustion or chemical reaction** (code 72). Fires started by heat from unclassified open flame or smoking materials (code 60) are allocated proportionally among the “other open flame or smoking material” codes (codes 61-69) in an allocation of partial unknown data. This includes smoking materials and candles. This approach results in any true unclassified smoking or open flame heat sources such as incense being inappropriately allocated. However, in many fires, this code was used as an unknown.

The equipment involved in ignition field is used to find several cause categories. This category includes equipment that functioned properly and equipment that malfunctioned.

Cooking equipment Non-confined fire refers to equipment used to cook, heat or warm food (codes 620-649 and 654). Fire in which ranges, ovens or microwave ovens, food warming appliances, fixed or portable cooking appliances, deep fat fryers, open fired charcoal or gas grills, grease hoods or ducts, or other cooking appliances) were involved in the ignition are said to be caused by cooking equipment. Food preparation devices that do not involve heating, such as can openers or food processors, are not included here. As noted in Appendix A, a proportional share of unclassified kitchen and cooking equipment (code 600) is included here.

Heating equipment Non-confined fire (codes 120-199) includes central heat, portable and fixed heaters (including wood stoves), fireplaces, chimneys, hot water heaters, and heat transfer equipment such as hot air ducts or hot water pipes. Heat pumps are not included. As noted in Appendix A, a proportional share of unclassified heating, ventilation and air condition equipment (code 100) is included here.

Electrical distribution and lighting equipment (codes 200-299) include: fixed wiring; transformers; associated overcurrent or disconnect equipment such as fuses or circuit breakers; meters; meter boxes; power switch gear; switches, receptacles and outlets; light fixtures, lamps, bulbs or lighting; signs; cords and plugs; generators, transformers, inverters, batteries and battery charges.

Torch, burner or soldering iron (codes 331-334) includes welding torches, cutting torches, Bunsen burners, plumber furnaces, blowtorches, and soldering equipment. As noted in Appendix A, a proportional share of shop tools and industrial equipment (code 300) is included here.

Clothes dryer or washer (codes 811, 813 and 814) includes clothes dryers alone, washer and dryer combinations within one frame, and washing machines for clothes. As noted in Appendix A, a proportional share of unclassified personal and household equipment (code 800) is included here.

Electronic, office or entertainment equipment (codes 700-799) includes: computers and related equipment; calculators and adding machines; telephones or answering machines; copiers; fax machines; paper shredders; typewriters; postage meters; other office equipment; musical instruments; stereo systems and/or components; televisions and cable TV converter boxes, cameras, excluding professional television studio cameras, video equipment and other electronic equipment. Older versions of NFIRS had a code for electronic equipment that included radar, X-rays, computers, telephones, and transmitter equipment.

Shop tools and industrial equipment excluding torches, burners or soldering irons (codes 300-330, 335-399) includes power tools; painting equipment; compressors; atomizing equipment; pumps; wet/dry vacuums; hoists, lifts or cranes; powered jacking equipment; water or gas drilling equipment; unclassified hydraulic equipment; heat-treating equipment; incinerators, industrial furnaces, ovens or kilns; pumps; compressors; internal combustion engines; conveyors; printing presses; casting, molding; or forging equipment; heat treating equipment; tar kettles; working or shaping machines; coating machines; chemical process equipment; waste recovery equipment; power transfer equipment; power takeoff; powered valves; bearings or brakes; picking, carding or weaving machines; testing equipment; gas regulators; separate motors; non-vehicular internal combustion engines; and unclassified shop tools and industrial equipment. As noted in Appendix A, a proportional share of shop tools and industrial equipment (code 300) is included here.

Medical equipment (codes 410-419) includes: dental, medical or other powered bed, chair or wheelchair; dental equipment; dialysis equipment; medical monitoring and imaging equipment; oxygen administration equipment; radiological equipment; medical sterilizers, therapeutic equipment and unclassified medical equipment. As noted in Appendix A, a proportional share of commercial and medical equipment (code 400) is included here.

Mobile property (vehicle) describes fires in which some type of mobile property was involved in ignition, regardless of whether the mobile property itself burned (mobile property involved codes 2 and 3).

Exposures are fires that are caused by the spread of or from another fire. These were identified by factor contributing to ignition code 71. This code is automatically applied when the exposure number is greater than zero.

Appendix C. Selected Published Incidents

The following are selected published incidents involving physical disabilities. Included are short articles from the “Firewatch” or “Bi-monthly” columns in *NFPA Journal* or its predecessor *Fire Journal* and incidents from either the large-loss fires report or catastrophic fires report. If available, investigation reports or NFPA Alert Bulletins are included and provide detailed information about the fires.

It is important to remember that this is anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs.

NFPA’s Fire Incident Data Organization (FIDO) identifies significant fires through a clipping service, the Internet and other sources. Additional information is obtained from the fire service and federal and state agencies. FIDO is the source for articles published in the “Firewatch” column of the *NFPA Journal* and many of the articles in this report.

Physical Disability: Bedridden

Alternative Heating Source Sparks Fatal Fire, New Jersey

A 64-year-old man and a bedridden 82-year-old woman were overcome by smoke in a fire that began in their home during a power outage caused by a snow storm.

The two-story, wood-frame, single-family home had smoke alarms on the first and second floors, but they did not operate. Nor were they properly located or sufficient for the house. There were no sprinklers.

A passerby discovered the fire and called 911 at 6:19 a.m. Firefighters arriving one minute later found flames coming from several rear windows on the first floor and police officers, who had arrived at the scene before the fire company, trying to force open the back door. Firefighters advanced a hose line through the front door, which had already been forced open by someone unknown, and eventually found the man in a bedroom on the second floor. They removed him from the house but, according to the fire department report, left the woman's body in place.

Fire investigators later determined that the fire started in a first-floor bedroom where the victims had set up a portable kerosene heater to keep them warm when the electric power went out.

The house, valued at \$300,000, and its contents, valued at \$150,000, were completely destroyed.

Kenneth J. Tremblay, 2013, "Firewatch", *NFPA Journal*, January/February, 20-21.

Discarded Cigarette Ignites Deadly Fire, Missouri

A bedridden 55-year-old man died in a fire that started when the 65-year-old woman who was taking care of him dropped a cigarette onto a chair in the living room, and the blaze spread throughout his home. The woman barely managed to escape with her life.

The one-story, wood-frame, single-family house, which had brick-veneer exterior walls and a roof covered in asphalt shingles, had a hardwired smoke detector with battery backup. There were no sprinklers.

The woman had woken at 2:30 a.m. to feed her charge, who slept in a hospital bed in the living room, then sat in a chair next to him, smoking a cigarette. At some point, she fell asleep and dropped the cigarette on the chair. When she woke up, she went back to her bedroom and slept until she was roused by the smoke alarm. By that time, the fire was free-burning.

The woman tried to extinguish the blaze with a bucket of water, but the heat and smoke forced her to retreat to the bathroom. She escaped through the bathroom window with the help of a passerby, who called 911 from his cell phone at 6:55 a.m.

The fire department estimated that the fire had been burning for approximately 3 hours before it was detected.

The man died of smoke inhalation. The house, valued at \$120,000, sustained \$30,000 worth of damage. Its contents, valued at \$12,000, sustained \$10,000 in damage.

Ken Tremblay, 2010, "Firewatch", *NFPA Journal*, May/June, 36-37.

Dryer Fire Kills Two, North Carolina

A fire that started in an electric dryer in the laundry room of a single-story, single-family house killed a bedridden 77-year-old woman and her 36-year-old granddaughter.

The wood-frame house, which measured 46 feet by 30 feet (14 meters by 9 meters), had smoke alarms in the hallway and the den, which operated as designed. There were no sprinklers in the dwelling.

The younger woman discovered the fire around 1:00 p.m. when she got out of the shower and smelled smoke. After discovering that the dryer was on fire, she called 911 and tried to get her grandmother out the house by dragging her across the floor and into the hallway. When fire conditions worsened, she covered her grandmother with her body to protect her. Firefighters entering the house found the two women in the hallway. The younger woman was pronounced dead at the scene. Her grandmother was still alive but died of her injuries hours later.

Investigators determined that the dryer's electric heating element ignited the clothes in the unit. The dryer vent was on the windward side of the house, and winds of 28 miles (45 kilometers) per hour, gusting up to 35 miles (56 kilometers) per hour, swept the fire through the house. A window the young woman broke while trying to escape was also on the windward side of the house.

The house, which was valued at \$100,000, and its contents, valued at \$50,000, were destroyed.

Kenneth J. Tremblay, 2008, "Firewatch," *NFPA Journal*, May/June, 26-28.

Physical Disability: Wheelchair User

Damaged Cord Starts Fatal Fire, North Carolina

A 68-year-old woman who used a wheelchair was fatally injured in a fire that began when an electrical cord running under a carpet and a loveseat from her freezer to a receptacle outlet ignited the carpet.

The one-story, single-family, wood-frame house was 40 feet (12 meters) long and 24 feet (7 meters) wide. Although the fire department said that it had installed a smoke alarm for the woman just a month before the fire, the alarm could not be located during the subsequent investigation. The house had no sprinklers.

A neighbor called 911 to report the fire at 9:46 p.m., but confusion as to the exact address caused some delay. When firefighters arrived at the scene, they found smoke and flames coming from one of the doors and noted that the interior was heavily involved. Firefighters had to extinguish the fire before they could reach the victim, who was taken to the hospital where she succumbed to smoke inhalation.

Investigators determined that the electrical cord had been damaged over time, finally creating enough heat to ignite the carpet and other combustibles in the living room.

The fire did an estimated \$15,000 damage to the building, valued at \$30,000, and \$7,000 to its contents, valued at \$22,000.

Kenneth J. Tremblay, 2009, "Firewatch," *NFPA Journal*, July/August, 18-19.

House Fire Kills Woman, Louisiana

A 33-year-old woman who used a wheelchair died as the result of a fire investigators believe was caused by improper electrical wiring. Her single-story, wood-frame house, which was 41 feet (12 meters) long and 25 feet (8 meters) wide, had no smoke alarms or sprinklers.

A neighbor discovered the fire and called 911 to report it at roughly 3:25 a.m. He then pushed in a window air conditioner and rescued a nine-year-old girl. Another window was blocked by a headboard. Firefighters arrived four minutes later and found the woman during their suppression operations. They transported her and the child to the hospital, where she died of smoke inhalation. The fire was declared under control about 90 minutes later.

Investigators determined that improper wiring in a receptacle outlet in the living room overheated and ignited nearby combustibles. The fire then spread throughout the house.

Damage to the home, valued at \$55,000, was estimated at \$35,000. Its contents, which were valued at \$15,000, were destroyed.

Kenneth J. Tremblay, 2009, "Firewatch," *NFPA Journal*, July/August, 20.

Smoking on Oxygen Causes Deadly Fire, Colorado

A 72-year-old woman who often smoked, even though she was on a home-assisted oxygen breathing apparatus, died in her home in an early-morning fire caused by her smoking materials.

The ranch-style, wood-frame house, which was 30 feet (9 meters) long and 28 feet (8 meters) wide, had exterior brick walls and an asphalt roof. It had neither smoke alarms nor sprinklers. The single-family home was occupied by the victim and two other adults.

One of the occupants awoke to the fire and called 911 at 4:12 a.m. Arriving police officers tried to enter through the front door, but they were driven back by high concentrations of heat and smoke.

However, one officer was able to remove a number of oxygen cylinders stored near the doorway, while others helped two occupants get out of the house through a front bedroom window. The fire quickly filled the living room window and the front door.

Fire crews arrived within five minutes of alarm and found heavy flames coming from the front and rear of the building. Just as an engine company was preparing to enter the front door with a hose line, they saw a white flash, heard a “whoosh” sound, and were driven back. A firefighter who fell on the ice while stepping away from the house injured his knee. Meanwhile, knocking down the blaze as they went through the house, the interior fire crew found the body of the 72-year-old woman, who had obvious burn injuries.

Investigators discovered that the fire started in the living room where the victim often slept and where they found an oxygen concentrator, a lift chair, a wheel chair, and other items the victim used. They determined that a cigarette ignited her upholstered chair and that the fire spread from the living room to the kitchen and bedrooms.

The woman, who was terminally ill, often smoked in the living room and had occasional episodes of unconsciousness during which she dropped her cigarette on the furniture, resulting in burn marks. She normally lit her first cigarette of the day around 4:00 a.m., which is consistent with the fire’s time frame.

As the victim often watched television with the volume turned up, the other two occupants slept with their doors closed, a barrier that provided enough time for their rescue.

The home, valued at \$140,000, and its contents, valued at \$20,000, sustained damages estimated at \$70,000 and \$16,000, respectively.

Kenneth J. Tremblay, 2008, “Firewatch,” *NFPA Journal*, March/April, 27-28.

Disabled Woman Dies from Fire Injuries, Mississippi

A fire that was extinguished with less than 500 gallons (1,892 liters) of water created enough smoke and heat to kill a disabled woman.

The single-story home was constructed of wood framing with an asphalt roof and a brick exterior wall. The home was 35 feet (10 meters) long and 40 feet (12 meters) wide and lacked smoke alarms and sprinklers. A portable, window-style air conditioning unit operating in a dining room arced from the electrical plug, which ignited the wooden baseboard. Flames spread to a nearby table, newspapers, and other combustibles within the room.

While transferring from the bed to the wheelchair, the victim landed on the floor. She called 911 to report the fire and to tell them she was trapped.

Firefighters responded with four engine companies at 8:39 p.m. and found heavy smoke coming from the house. Fire was visible in the front windows. Using a 1-3/4-inch hose line, a hose team advanced into the home and moved to the right after entering toward the dining room. Another crew entered and turned left toward the bedroom areas in search of the occupant.

The fire department was knowledgeable of the home, as they had assisted the woman in the past. Firefighters found the victim's bedroom and tried to open the door but found it blocked. Using a second door, firefighters found the victim on the floor. The fire was quickly extinguished with significant heat damage throughout the dwelling.

The victim was treated on scene and transported to the hospital for stabilization and eventually taken to a trauma hospital, but her injuries were so severe she died about a week later. Investigators determined that the fire started when an aftermarket electrical plug was attached to the end of the cord powering the air conditioner. This connection arced and started the fire. Heat from the fire melted plastic ceiling tiles in the victim's bedroom as they dripped to the floor.

The home, valued at \$50,000 with contents of \$10,000, suffered building losses of \$20,000 and contents losses of \$7,000. There were no firefighter injuries.

Kenneth J. Tremblay, 2007, "Firewatch," *NFPA Journal*, September/October 29-30.

Physical Disability: Walker User

Unattended Cooking Fire Kills Elderly Man, Virginia

A 92-year-old man, who was unable to walk without the assistance of a walker, died of burns when his clothes ignited as he tried to turn off an electric burner on the stove in his apartment after a pan of cooking oil caught fire.

The 14-story, 203-unit, steel-frame apartment building had concrete floors and walls. Each unit had local smoke alarms, and a fire detection system protected all the common areas. There were no sprinklers.

The fire began when the man overheated the oil he had put in a pan to fry a steak. When he saw the flames, he reached for the controls at the rear of the range to shut off the stove burner, and in the process, ignited his clothes. He used water from the sink and another pan to control the flames, then removed his clothes and made his way to the foyer, where a neighbor heard him calling for help and called 911.

The victim was conscious and alert upon arrival at the hospital, but he later died. There were no structural damages to the victim's unit. Damage to its contents, valued at \$100,000, was estimated at \$2,000.

Kenneth J. Tremblay, 2014, "Firewatch", *NFPA Journal*, January/February 31-32.

Using Accelerants with Wood Stove Leads to Deadly Fire, Wisconsin

An 87-year-old man died of smoke inhalation in a fire that engulfed his home before a neighbor noticed it and called the fire department at 8:29 p.m.

The two-story, wood-frame house was 40 feet (12 meters) long and 24 feet (7 meters) wide. It had no smoke alarms or sprinklers.

Responding firefighters extinguished the fire and found the body of the victim, who used a walker, between a wood-burning stove in the kitchen and the nearest exit.

Investigators determined that the blaze started near the stove, next to which they found a container of diesel fuel or a similar liquid.

They learned that the victim had a history of using accelerants to start fires in the stove.

The house, which was valued at \$39,000, and its contents, valued at \$21,000, were destroyed.

Kenneth J. Tremblay, 2013, "Firewatch", *NFPA Journal*, May/June 26-27.

Woman Dies in Fire Involving Medical Oxygen, Missouri

Despite the help of a neighbor, a 73-year-old woman who had recently returned home after surgery and used medical oxygen died in a fire in her single-family home. She and her husband, who managed to escape, both had difficulty walking. She used a walker, and he used an electric scooter.

The two-story, wood-frame house, which was 66 feet (20 meters) long and 30 feet (9 meters) wide, had smoke alarms, but they were not operational. There were no sprinklers.

The fire was reported by a neighbor, who had gone to his kitchen to get a drink of water and noticed smoke and flames coming from the victims' front door. After calling 911 at 12:15 a.m., he ran over and found the woman's husband sitting on a lawn chair behind the home. When he asked him where his wife was, he said that she was still inside.

The neighbor entered the house, got to his knees because of the intense heat and smoke, and called out to the woman. She answered and told him she was in a living room chair. He crawled through the living room until he found her and dragged her along the floor and out the door.

Arriving firefighters found flames enveloping the entire front door, and a captain advised that the structure was fully involved. The engine and ladder crews worked together to deploy hose lines to knock down the fire and enter the house, while additional companies arrived to help the two occupants, first moving them farther away from the burning home. Although neither initially reported any problems, the woman said she had difficulty breathing and was taken to the hospital. While en route, she told the EMS crew that she had lit a cigarette while using medical oxygen and had seen a flash.

Her husband told the fire investigators that the oxygen concentrator, which was found at the point of fire origin, was plugged in at the time of the blaze. The investigators determined that the fire was caused by smoking while using medical oxygen, which intensified the fire.

The fire did \$70,000 worth of damage to the house, which was valued at \$140,000. Its contents, valued at \$90,000, also sustained an estimated \$70,000 in damage.

Kenneth J. Tremblay, 2012, "Firewatch," *NFPA Journal*, September/October 28.

Extension Cord Blamed for Fire that Kills Two, Indiana

A 74-year-old woman died in their home when a small-gauge electrical extension cord powering a window mounted air conditioner overheated and ignited the living room's combustible contents.

The one-story, single-family, wood-frame house, which was 40 feet (12 meters) long and 24 feet (7 meters) wide, had no sprinklers. Firefighters found the only smoke alarms in the house on a kitchen counter without working batteries.

A passerby discovered the fire and contacted 911 at 1:53 a.m. The responding firefighters quickly extinguished the blaze and found the bodies of the two victims, each of whom used a walker, in the living room and in the hallway that led to the bedrooms.

Investigators discovered that electrical extension cords had been used to power appliances throughout the house. They noted that the cord to the air conditioner had been covered with combustibles.

In addition, the victims were hoarders, and the house contained so much material that virtually the only way to get from room to room was to follow paths through the clutter. The family of the victims had tried repeatedly but without success to encourage the couple to clean the house or move to an assisted-living facility.

The fire report suggests that the hoarding played a role in the fire's early growth, but that the couple's disabilities were more important than the restricted egress paths in explaining their inability to rescue themselves.

The house, valued at \$70,000, sustained an estimated \$40,000 in damage. Its contents, valued at \$30,000, sustained \$15,000 in damage.

Kenneth J. Tremblay, 2012, "Firewatch" *NFPA Journal*, July/August, 20-21.

Two Dead in House Fire, Texas

A fire in a single-family home that started on a front porch that had been enclosed to make a room flashed over and spread through the structure, killing a 52-year-old man and a 49-year-old woman. The man had back problems that reduced his mobility, and the woman sometimes used a walker. Both victims were intoxicated.

The single-story, wood-frame house was 30 feet (9 meters) long by 35 feet (11 meters) wide. It had two bedrooms, a bathroom, a kitchen, a living room, and the porch that had been enclosed to add another room. There were no smoke alarms or sprinklers.

A visitor to the house next door saw the fire through the windows as he approached and ran around the burning house banging on windows. He noticed that the back door was open, but he was unable to see inside.

Responding to an 8 p.m. call, firefighters arrived to find smoke and flames coming from the windows on two sides of the house. They advanced a 2-inch (5-centimeter) hose line through the front door, knocked down the heavy fire on the porch, and went into the house, where they found the first victim between the front room and the living room. They discovered the other victim in the kitchen during their secondary search.

Investigators determined that the fire started in the enclosed porch in an entertainment cabinet containing a television, VCR, and other electronic equipment. It was most likely the result of some type of electrical problem in one of the components. The fire heavily damaged the addition and the front of the house before it spread through an open door to the main body of the house.

The house, which was valued at \$62,000, and its contents, valued at \$22,000, were destroyed. Alcohol intoxication was a contributing factor in the couple's deaths.

Kenneth J. Tremblay, 2011, "Firewatch" *NFPA Journal*, March/April, 25-26.

Smoking Material Starts Fatal Fire, South Carolina

A 56-year-old woman with mobility and cognitive limitations died of burns and smoke inhalation when her clothes ignited as she tried to escape a fire in her unsprinklered single-family home.

The single-story, wood-frame house was 36 feet (11 meters) long and 24 feet (7 meters) wide. There was a smoke alarm in the living room, but investigators could not determine whether it operated.

The victim had a habit of dropping cigarettes in her house, and investigators believe that she dropped one into a wicker trash basket in a hallway, where the heat from the cigarette ignited the trash. To escape from her bedroom, the woman had to pass the burning trash basket in a narrow hallway and did so without her walker, which she often refused to use. Investigators concluded that her awkward movements near the fire caused her clothes to ignite. She moved an additional 5 feet (1.5 meters) before she fell and died. The fire, which burned itself out, went unnoticed until a family member returned to the home and found the victim's body.

The home, valued at \$80,000, and its contents, valued at \$15,000, sustained a loss of less than \$500.

Ken Tremblay, 2010, "Firewatch," *NFPA Journal*, July/August, 24.

Smoking, Medical Oxygen Result in Fire Death, Kansas

A 64-year-old man died in a fire that began when he dropped a cigarette on the sofa in the living room of his apartment. The man was using oxygen at the time, and the fire intensified as it spread along the tubing.

The one-bedroom apartment was located in a single-story, unsprinklered, wood-frame duplex with a wooden truss roof covered by asphalt shingles. It had smoke alarm but its operation was not reported.

The victim's next door neighbors called 911 at 8:24 p.m. when they returned home to find his windows blackened by smoke. By the time firefighters arrived, the fire was coming from the roof.

Crews entered the apartment and discovered the victim, who had a history of smoking and drinking heavily, in the living room. As they pulled him from the dwelling and began CPR, another team entered the building and extinguished the fire.

Investigators believe careless smoking cause the fire, which damaged the living room, hallway, and the bedroom where the oxygen concentrator was located. Three cylinders of oxygen were found in the room, but they were not involved in ignition.

The home sustained \$15,000 in damage. The victim, who used a walker, died of severe burns and smoke inhalation.

Ken Tremblay, 2009, "Firewatch," *NFPA Journal*, November/December, 21-22.

Sensory Disability: Deaf or Hearing Impairment

Smoke Kills 100-year-old Woman, Nebraska

A 100-year-old woman with a hearing impairment died in a fire that started in her single-family home's heating system and spread until it was detected by a neighbor. The woman did not have her hearing aids in place, and investigators believe the smoke alarm was not loud enough to alert her to the fire without them.

The unsprinklered, single-story, wood-frame house was 60 feet (18 meters) long by 30 feet (9 meters) wide. Its smoke alarm was located in the hallway near the bedrooms.

Investigators determined that the fire began in a basement furnace. It was an older model that required the operation of certain valves, and the investigators think the woman was unsure what position the valves should be in. When the furnace operated with the return line shut off, it malfunctioned and started the fire, which was not detected until smoke reached the upper level.

The house, valued at \$100,000, and its contents, also valued at \$100,000, were destroyed.

Kenneth J. Tremblay, 2008, "Firewatch," *NFPA Journal*, September/October, 29.

Fire Kills Family in New Home, Idaho

An early morning fire that started in a bedroom in a one-story manufactured home killed an 8-year-old girl, a 38-year-old man, and a 19-year-old woman the day they moved into their home. The man and the woman, who was eight months pregnant, were deaf, and the home had no smoke alarms for the hearing impaired.

A passerby called 911 at 2:30 a.m. to report fire coming from a window of the unsprinklered home, and responding firefighters found smoke and flames coming from the front-left corner of the dwelling.

They advanced a hose line to the front door, forced the door, and entered the home in search of three occupants reportedly still inside. They located all three and took them outside for medical treatment, but the victims died of smoke inhalation. An emergency Cesarean section on the mother failed to save the baby.

The home, valued at \$10,000, and its contents, which were valued at \$5,000, were destroyed.

Kenneth J. Tremblay, 2008, "Firewatch," *NFPA Journal*, July/August 22.

Sensory Disability: Visual impairment

Overloaded Power Strip Starts Fatal Fire, California

A 55-year-old man who had several disabilities, including blindness, died of exposure to heat and smoke in a fire that started in the bedroom where he was sleeping.

The man lived alone in a 900-square-foot (84-square-meter), single-story, wood-frame house. The house was equipped with a battery-operated smoke alarm, but the battery was reported to have been removed on the evening of the fire, when smoke from cooking set it off. The house had no fire sprinklers.

A neighbor heard banging and other activity about an hour before the fire was reported. This was not uncommon, but when it continued, the neighbor investigated, saw the fire, and called 911 around 4 a.m.

Investigators determined that several electrical appliances with large-diameter power cords were plugged into a power strip that was covered by clothes and books. The overloaded strip eventually generated enough heat to ignite the items covering it, and the fire spread to other combustibles in the room. A home oxygen generator and a spare oxygen bottle became involved and contributed to the fire's intensity.

The house and its contents, valued at \$100,000 and \$40,000, respectively, were destroyed. In addition to the victim's disabilities, blood tests revealed that he was both intoxicated and had both legal and illicit drugs in his blood stream when he died.

Kenneth J. Tremblay, 2012, "Firewatch," *NFPA Journal*, March/April, 14.

Medical Oxygen Contributes to Fatal Apartment Fire, Washington

An 80-year-old blind woman who was using home oxygen died in a fire that began when a heated towel she had in her lap ignited combustibles on or near the couch on which she was sitting.

The fire occurred in a fourth-floor unit of a six-story apartment building in which roughly 150 low-income older adults lived. The structure was of fire-resistive construction, with block walls and cement floors and ceilings. The building had a new wing and an old wing, which resulted in variations in fire detection and suppression systems. The old wing, in which the fire occurred, did not have sprinklers. The alarm system was being upgraded, but only single-station smoke alarms and pull stations were present at the time of the fire.

The smoke alarm alerted nearby residents, and the fire department was notified by pull stations and a 911 call shortly after 6 p.m. When a caregiver arrived at the apartment of origin, she heard the woman cry. She opened the door, crawled into the burning apartment, pulled the woman out, and took her to a neighbor's unit.

By the time firefighters arrived, smoke and flames were venting out a window. Crews raised an aerial ladder and used a ladder pipe to knock down the blaze before advancing hose lines to the fourth floor and completing extinguishment. The fire was confined to the unit of origin, but smoke affected portions of the fourth, fifth, and sixth floors. The fourth-floor hallway suffered heavy smoke and heat damage, but smoke damage to the fourth-floor units whose doors were closed was minor.

The woman, who suffered from burns and smoke inhalation, died of her injuries, but she lived long enough to tell investigators how the fire started. She had put a towel in her new microwave oven to warm it, removed the towel, and unfolded it. As it was being unfolded, she said, the overheated towel began burning. Investigators determined that oxygen flowing from an oxygen generator that was filling a nasal cannula on the living room floor was a contributing factor.

During the fire, six other residents of the building suffered smoke inhalation or stress-related injuries. An 88-year-old woman who had left the hospital without being treated died of a heart condition the following day.

The building, valued at \$8 million, sustained damage estimated at \$323,000. Its contents, valued at \$1 million, sustained a \$15,000 loss.

Kenneth J. Tremblay, 2011, "Firewatch" *NFPA Journal*, March/April, 24-25.

Disabled Woman Dies in Cooking Fire, Pennsylvania

A 73-year-old woman who was blind and used a wheelchair died of burns she suffered when she dropped a foil-and-paper-wrapped sandwich that had caught fire in her microwave onto her lap.

The four-story, steel-frame masonry apartment building, which was 100 feet (30 meters) long and 75 feet (23 meters) wide, had a fire suppression system and a fire detection system that alerted the occupants and the fire department at 5:52 p.m. Responding firefighters discovered that the fire was so small it had extinguished itself before the sprinklers could operate.

Investigators believe that the woman put the sandwich in the microwave, not realizing that it was wrapped in aluminum foil under the paper. When she turned the microwave on, the foil arced and ignited the paper covering the sandwich. After retrieving the burning sandwich from the microwave, the woman dropped it in her lap, where it ignited her clothing. The fire enveloped the victim, but did not spread any further.

Damage to the building and its contents was estimated at \$25,000. Two other building occupants, ages 86 and 63, suffered smoke inhalation.

Kenneth J. Tremblay, 2010, "Firewatch," *NFPA Journal*, January/February, 24-25.

Visually Impaired Woman Dies in House Fire, Kentucky

A woman with a visual impairment died of smoke- and heat-related injuries when a fire started on or near a recliner in her living room.

The unsprinklered, single-family, wood-frame house had a brick veneer and covered approximately 2,400 square feet (223 square meters). The fire department report states that investigators could not determine whether the house had any smoke detectors.

Firefighters received several calls from passersby and neighbors at 6:08 p.m. reporting that smoke was coming from the house and that a woman was trapped inside. Fire crews responding within four minutes found heavy black smoke coming from the rear of the house and the windows covered with soot. Witnesses told firefighters that the woman, who was alone, was still in the house in the front room.

A fire crew entered the house and, despite the smoke obscuring visibility above knee level, quickly found the victim's body on an end table by the front door. The firefighters extinguished hot spots in the living room and kitchen. Fire damage was limited to the living room and adjacent areas, although there was heavy smoke damage throughout the house.

The victim, whose age was not reported, had been on the phone with relatives about 15 minutes before the fire was detected.

Investigators could not determine the cause of the fire or what prevented the woman from evacuating.

Damage to the structure, valued at \$85,000, was approximately \$50,000; damage to its contents was estimated at \$20,000.

Kenneth J. Tremblay, 2008, "Firewatch," *NFPA Journal*, September/October, 29.