NFPA® RESEARCH

Home Structure Fires

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Key findings

More than one-quarter of the reported fires in 2014–2018 (27 percent) occurred in home environments. In addition, more than three-quarters of civilian fire deaths (77 percent) and almost three-quarters of reported civilian fire injuries[i] (73 percent) were caused by home[ii] structure fires.

During this five-year period, US fire departments responded to an estimated average of 353,100 home structure fires per year. These fires caused an annual average of 2,620 civilian deaths; 11,030 civilian fire injuries; and $7.2 billion in direct property damage.

Sixty-nine percent of the reported home fires in 2014–2018 were in one- or two-family homes, including manufactured homes. These fires caused 85 percent of the home fire deaths, 65 percent of the home fire injuries, and 79 percent of the direct property damage from home fires.

Certain scenarios appear more dangerous than in the past. The death rate per 1,000 reported home fires in 2014–2018 that began with the ignition of either upholstered furniture or mattresses and bedding was more than double what it was in 1980–1984.

Most home fires and fire casualties result from five causes: cooking, heating equipment, electrical distribution and lighting equipment,[iii] intentional fire setting, and smoking materials. Over the five-year period of 2014–2018 in total, cooking was the leading cause of home fires and home fire injuries. Smoking materials caused the most home fire deaths.

While reported home fires and home fire deaths have been cut roughly in half since 1980, and population-based home fire and home fire death rates have fallen by roughly two-thirds, the death rate per 1,000 reported home fires has remained fairly consistent. This rate was slightly higher in most recent years than it was in 1980. The change was driven by an even more pronounced increase in the death rate in one- or two-family home fires. It appears that most of the reduction in fire deaths over the past decades has been due to a reduction in fires rather than the prevention of harm after a fire is reported.

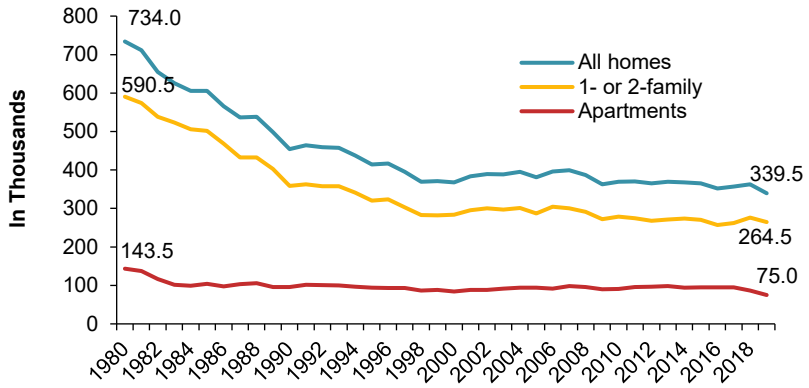
Trends in reported fires

Figure 1 shows that the 2019 estimate of 339,500 reported home fires was 54 percent lower than the estimate of 734,000 in 1980. These results, which come from the NFPA Fire Experience Survey, are provided annually in the NFPA *Fire Loss in the United States* series.[1] The decline in reported fires was sharpest during the 1980s, continued more slowly in the 1990s, and mostly leveled off in the past two decades. With a 6 percent drop from 2018 to 2019, the 2019 estimate was a new low.

The 2019 estimate of reported fires in one- or two-family homes was 55 percent lower in 2019 than in 1980. Estimated fires in apartments or other multifamily structures were 48 percent lower. From 2018 to 2019, fires in one- or two-family homes fell 4 percent, while apartment fires fell 13 percent to a record low.

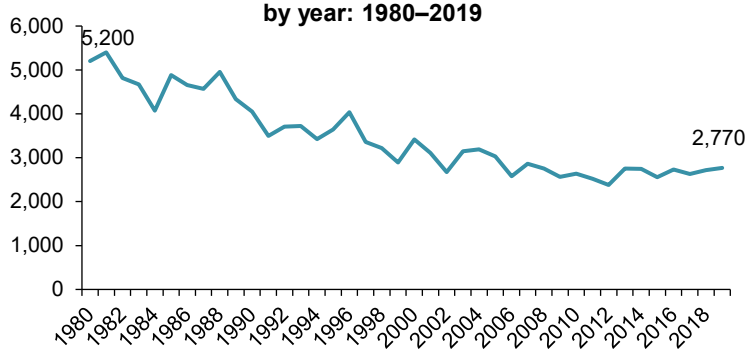
The 2019 home fire death toll of 2,770 was 47 percent lower than the 5,200 deaths in 1980. See Figure 2.

Figure 1. Reported home structure fires by year: 1980–2019



[i] Death and injury estimates exclude firefighter casualties.
[ii] The term *home* includes one- or two-family homes, manufactured homes, and apartments or other multifamily housing, regardless of ownership.
[iii] Electrical distribution and lighting equipment include installed wiring, outlets, switches, cords, plugs, power supplies, and lighting.

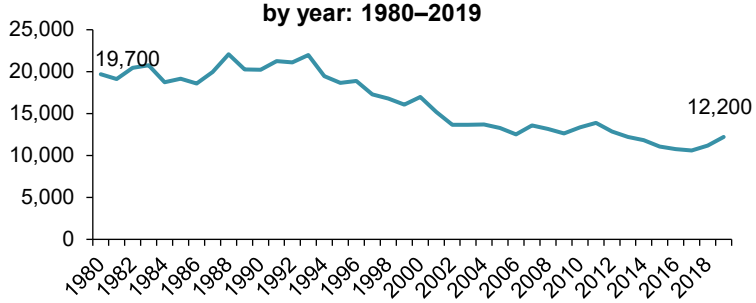
Figure 2. Home structure fire deaths by year: 1980–2019



The estimate of reported home fire injuries in 2019 was 38 percent lower than the 1980 estimate. See Figure 3.

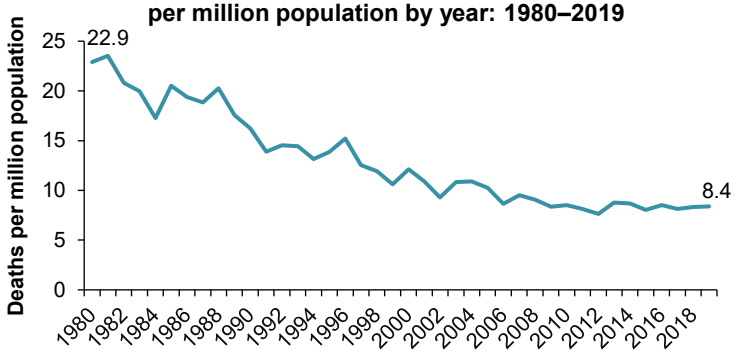
Population-based home fire and fire death rates in 2018 were roughly one-third the rate from 1980. The rate of reported home fires per thousand population fell from 3.2 in 1980 to 1.0 in 2019. The 2019 rate of 8.4 home fire deaths per million population was 63 percent lower than the 22.9 deaths per million population in 1980. See Figure 4.

Figure 3. Reported home structure fire injuries by year: 1980–2019



Less progress has been made in reducing deaths and injuries in *reported* home fires. In 1980, there were 7.1 deaths per 1,000 reported home fires overall. This was also true for one- or two-family homes and apartments. Forty years later, the death rate per 1,000 fires had fallen 29 percent to 5.1 for apartment fires, increased 15 percent to 8.2 for overall home fires, and

Figure 4. Reported home fire death rates per million population by year: 1980–2019



climbed even more to 9.0 in one- or two-family homes. While the rates fluctuated, there was only one year in which the death rate per 1,000 one- or two-family home fires was lower than it was in 1980. Apartment fire death rates had a fairly consistent downward trend. In most years, the rate for overall homes is higher than in 1980 due to the larger share of one- or two-family homes. See Figure 5.

The 2019 rate of 45.3 civilian injuries per 1,000 apartment fires was 81 percent higher than the 1980 rate of 25.1. For one- or two-family home fires, the 2019 rate of 33.3 injuries per 1,000 fires was 22 percent higher than the 1980 rate of 27.3. The 35.9 injuries per 1,000 home fires overall in 2019 was 34 percent higher than the 26.8 rate in 1980. See Figure 6.

One reason for the disparity between the rates for apartment fires and one- or two-family home fires might be that more code requirements regulate apartments than one- or two-family homes. As a result, apartment buildings are more likely to have monitored smoke detection systems that notify the fire department when activated. This could result in more minor fires reported in apartment properties. In 2014–2018, 62 percent of the reported apartment fires had incident types indicating a confined cooking fire. Many were extinguished by the time the fire department arrived. Only 26 percent of fires in or two-family home fires were confined cooking fires. Apartments are also more likely to have sprinklers than one- or two-family homes

Figure 5. Deaths per 1,000 reported home fires by year and occupancy: 1980–2019

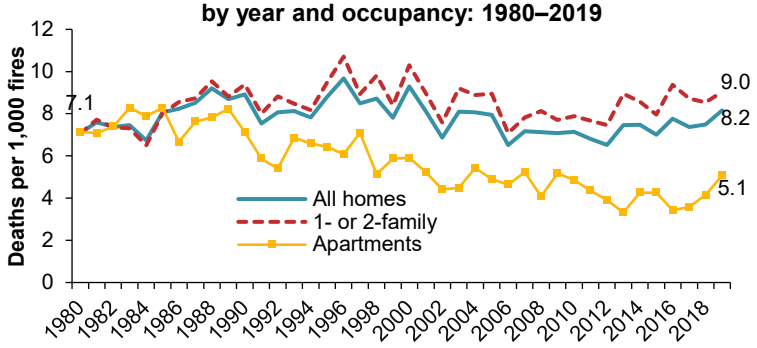
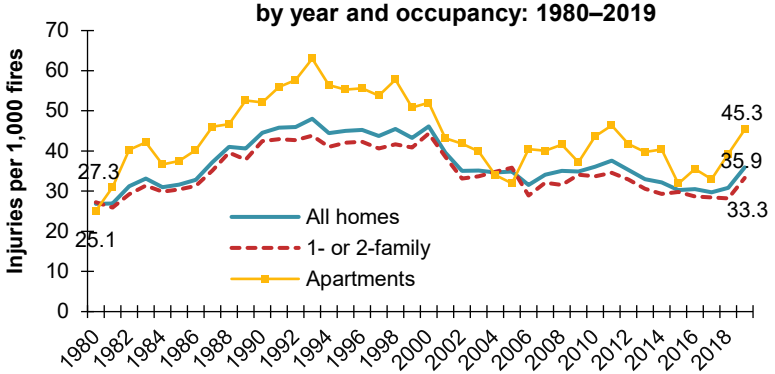


Figure 6. Injuries per 1,000 reported home fires by year and occupancy: 1980–2019



About the data

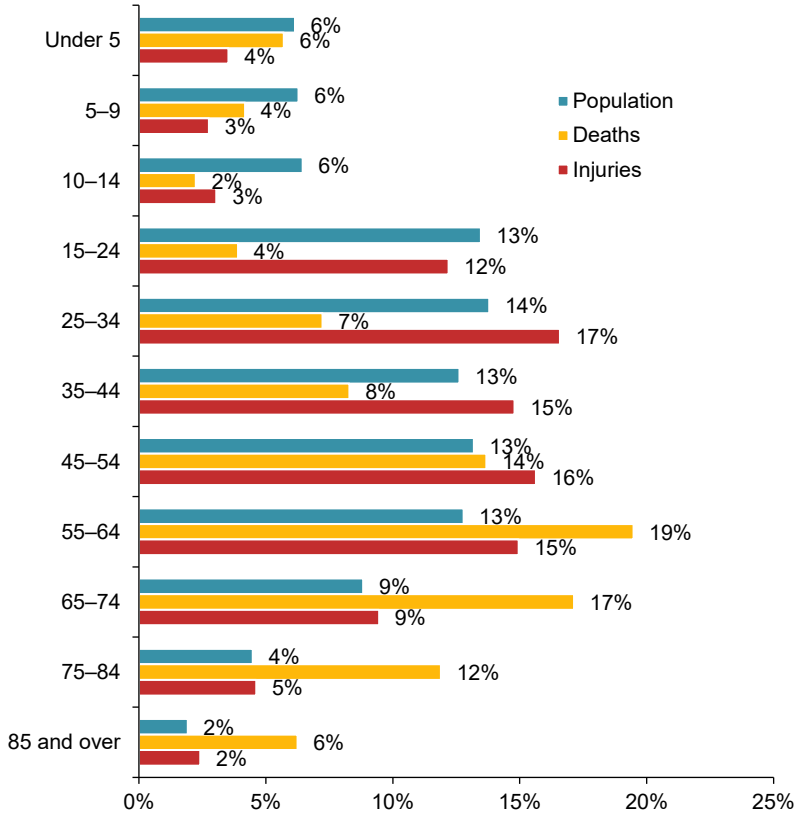
The trends discussed above are based on summary data collected by NFPA's fire department experience survey. The survey results are combined with the more detailed, incident-based National Fire Incident Reporting System (NFIRS) data to provide a deeper understanding of the causes and circumstances of these fires. The most current NFIRS national dataset is for 2018. Estimates are typically presented as national averages. Unknown data were allocated proportionally.

Who are the victims?

Of the people who died in home fires, 56 percent were male, as were 54 percent of those non-fatally injured. Gilbert and Butry determined that population "frailty," defined by age- and gender-adjusted natural cause mortality rates, can identify populations vulnerable to fire death but not those vulnerable to non-fatal injuries.[2]

Figure 7 shows that more than half of the fatal home fire victims were 55 and over (55 percent), while more than one-third were at least 65 years old (35 percent). One of every five fatal home fire victims was between 55 and 64 years of age (19 percent).

Figure 7. Home fire deaths and injuries by age group: 2014–2018



More than three of every five people who were non-fatally injured were between 25 and 64 years of age (62 percent). NFPA's 2018 report, *Home Fire Victims by Age and Gender,* provides more details on the age and gender of casualties by the leading causes of fires reported in 2011–2015.

When are home fires most common?

Not surprisingly, home structure fires are more common in cooler months when people spend more time inside, as well as in the hours when people are awake in the home. In 2014–2018, 47 percent of home structure fires and 56 percent of home structure fire deaths occurred in the five-month span of November through March. Reported home fires peaked from 5:00 to 8:00 p.m., when many people are coming home from work, preparing dinner, or engaging in other household activities. Only one-fifth of home fires were reported between 11:00 p.m. and 7:00 a.m. (19 percent), but these fires caused half of the home fire deaths. One-third of the people who were fatally injured in home fires during 2011–2015 (32 percent) were asleep at the time.[3] However, people may be sleeping at any hour.

Leading causes of home fires

The graphs showing the leading causes of fires and associated losses in 2014-2018 use estimates pulled from several data elements in NFIRS, so double counting is possible. The likely severity of a reported fire can be measured in deaths or injuries per 1,000 fires and average property loss per fire.

Figure 8 shows that cooking was the leading cause of reported home structure fires and civilian fire injuries and the second leading cause of civilian fire deaths. Cooking caused an average of 172,900 home fires per year. These fires caused an annual average of 550 civilian deaths; 4,820 civilian injuries; and $1.2 billion in property damage. Cooking was the leading cause of fires in both one- or two-family homes and apartments but it caused a much larger share of fires in the latter (73 percent) than in one- or two-family homes (38 percent). While cooking was the leading cause of fires and fire injuries, it ranked lower on casualties per 1,000 reported fires (3 deaths and 28 injuries) and last among the major causes of average loss per reported fire ($6,900). See the NFPA report *Home Cooking Fires* for more details on how cooking fires start.

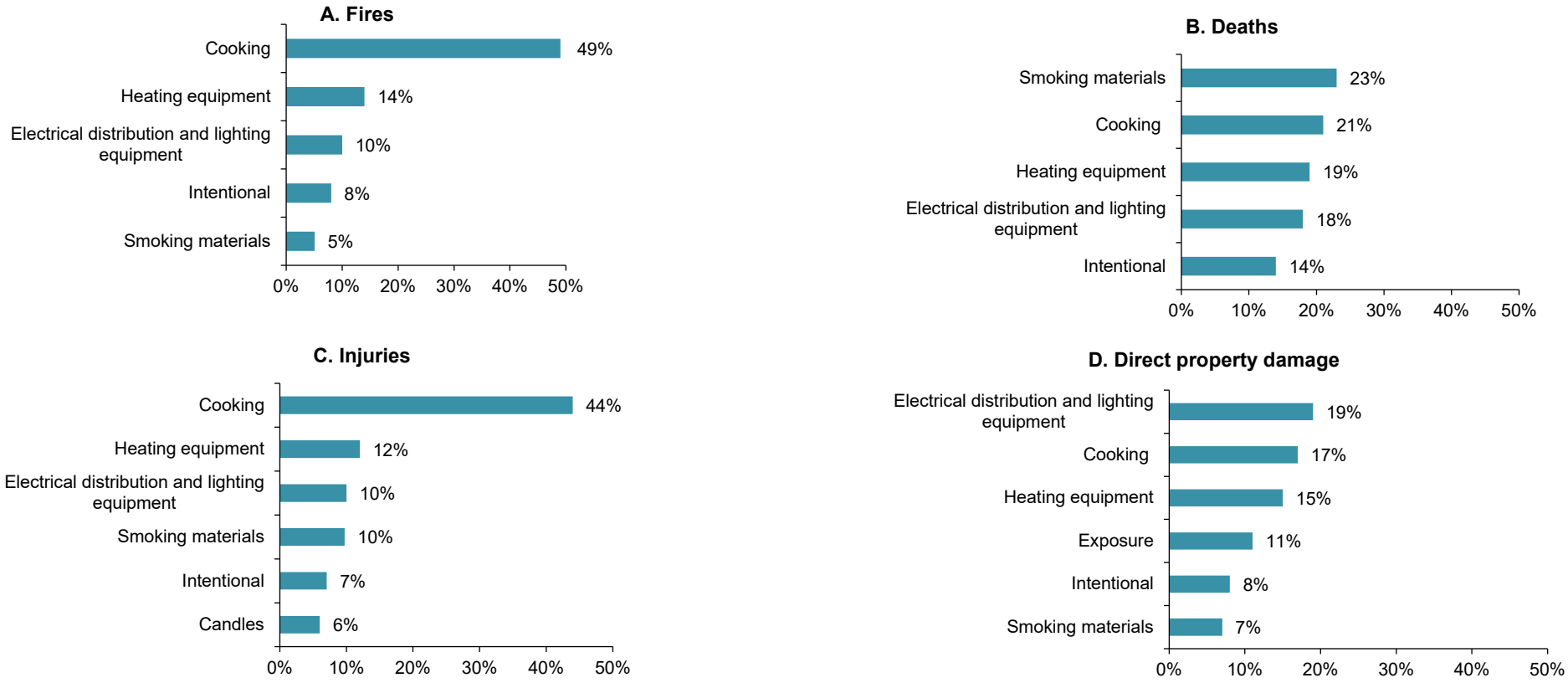
Fires started by smoking materials have been the leading cause or one of the leading causes of home fire fatalities for decades. This was still true for the 2014–2018 period as a whole. During this period, an estimated average of 16,800 such fires caused an average of 590 deaths; 1,050 injuries; and $492 million in direct property damage annually. The 35 deaths and 63 injuries per 1,000 reported fires caused by smoking materials was five times the rate of deaths (7) and twice the rate of injuries (31) per 1,000 reported home fires overall. For more information, see the NFPA report, *Home Fire Started by Smoking*.

Heating equipment was the second leading cause of home fires and home fire injuries, and the third leading cause of home fire deaths. An average of 48,500 such fires caused 500 deaths; 1,350 injuries; and $1.1 billion in direct property damage per year. Heating equipment was the leading cause of fire deaths in one- or two-family homes. Chimney fires, usually minor and in one- or two-family homes, were the most common type of heating fire. [iv] Although space heaters, including portable heaters and those that are permanently installed, were involved in only 4 percent of the total fires, these incidents accounted for 15 percent of all home fire deaths. For more information, see the NFPA report, *Home Fires Involving Heating Equipment*.

Electrical distribution or lighting equipment was the leading cause of home fire property damage. An average of 33,900 such fires caused 470 deaths; 1,100 injuries; and $1.4 billion in direct property damage annually. Wiring and related equipment accounted for 7 percent of all home fires and 9 percent of all home fire deaths. Cords or plugs were involved in only 1 percent of the fires but 7 percent of the deaths. Extension cords dominated the cord or plug category. While electrical failures or malfunctions were most common contributing factor to these incidents, they were not the only factor.

[iv] In this report, any home fire with an incident type of confined chimney or flue fire is considered a chimney fire. The *Home Fires Involving Heating Equipment* report includes a breakdown of equipment in these confined chimney or flue fires. Consequently, it shows more fireplaces and fixed heaters, usually wood stoves and fewer chimney fires.

Figure 8. Leading causes of home structure fires: 2014–2018



Electrical failures or malfunctions can occur in any type of equipment powered by electricity. In 2012-2016, half of these fires involved electrical distribution or lighting equipment.[4] Cooking equipment, heating equipment, fans, air conditioners and dryers accounted for most of the remaining home fires started by electrical failure or malfunction fires. More information is available in the NFPA report, *Home Electrical Fires.*

The 28,300 intentional home fires per year caused an annual average of 370 deaths, 790 injuries, and $547 million in direct property damage. More information is available in the NFPA report, *Intentional Fires.*

According to death certificate data, 64 percent of all intentional fire or flame deaths in 2014–2018 (including non-home fires) were suicides.[5] Conventional fire prevention and fire protection efforts alone cannot prevent these deaths.

Intentional fires heavily overlap with, but are not identical to, legally defined arson fires. For example, children under the age of legal responsibility sometimes intentionally start fires.

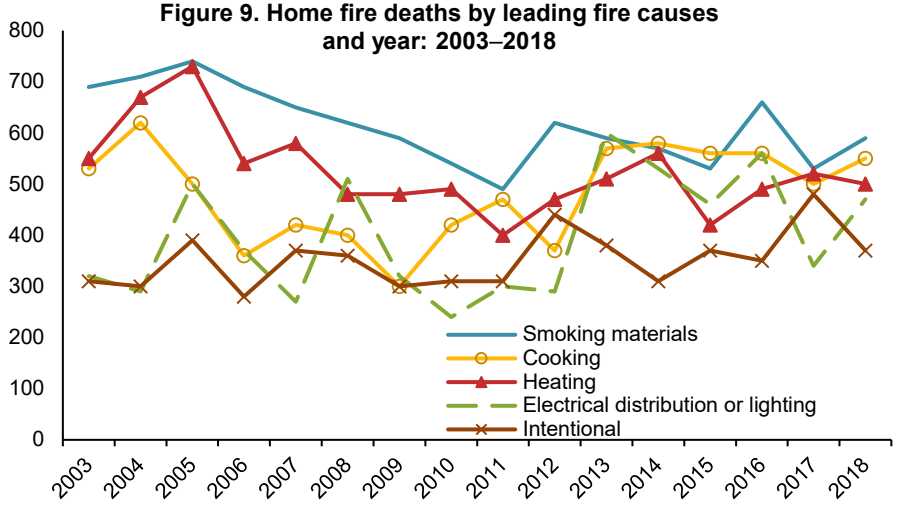
Candles started an average of 7,600 home fires annually (2 percent of all home fires), resulting in an average of 80 deaths (3 percent), 680 injuries (6 percent), and $278 million in direct property damage (4 percent) per year.

Candle fires had an injury rate of 89 per 1,000 reported fires, roughly three times the overall home fire injury rate.

Fires caused by exposure to another fire had the highest average property loss per fire of all the major causes. The 12,300 home fires per year resulting from exposure (3 percent) caused an average of 20 deaths (1 percent), 60 injuries (1 percent), and $792 million in direct property damage (11 percent) annually. The average loss of $64,400 per exposure fire was more than three times higher than the overall average loss of $20,400 per fire.

In recent years, the leading causes of home fire deaths have converged more than in the past. For most of the past few decades, smoking materials were clearly the leading cause. While smoking materials were the leading cause of home fire deaths over the five-year period of 2014–2018, cooking was the leading cause in 2014 and 2015. Electrical distribution and lighting equipment caused the largest number of home fire deaths in 2013. Smoking materials caused the largest number of deaths in 2016–2018. See Figure 9.

Figure 9. Home fire deaths by leading fire causes and year: 2003–2018



Xiong, Bruck, and Ball conducted interviews with Australians who survived unintentional residential fires without serious injury. They grouped the fire causes into three broad categories: unsafe human behaviors, human long-term inaction, and no human action involved.[6] Their approach could provide insights into the US experience.

Unsafe human behaviors were reported in almost half of the Australian fires (46 percent) and typically occurred within a short time (hours at most) of the behavior and the start of the fire. Unattended cooking, playing with fire, combustibles too close to a heat source, and discarded cigarettes are examples of unsafe behaviors. Forgetfulness and distraction were also mentioned frequently.

Compared to fires with no human involvement, unsafe human behaviors were commonly seen in fires when one or more of the following was true: the individual was in the room of origin when the fire started; the kitchen was the room of origin; the individual suffered from mental illness; the fire was in an apartment or rental property; or the individual suffered from physical illness, was not working full-time, or was asleep.

Human long-term inaction, such as a failure to clean grease or creosote build-up, failing to replace worn-out equipment, or overloading equipment caused 14 percent of these fires.

However, 40 percent of the fires were not attributed to any human action. These fires were typically started by faults in electrical or ignition systems.

These categories could be applied to the traditional US fire causes mentioned throughout this report. For example, a review of the factors contributing to ignition in cooking fires in 2014–2018 shows that the vast majority of these fires and casualties were caused by unsafe human behaviors, such as unattended cooking, abandoned material, combustibles too close to cooking equipment, unclassified misuse of material, or equipment that is unintentionally turned on or not turned off.[7] Failure to clean the grease from a stovetop or oven is an example of human long-term inaction. Roughly 10 percent of cooking fires were caused by mechanical or electrical failures or malfunctions, which are general examples of fires with no human action involved. In some cases, these failures may have occurred because the equipment was worn out.

Similar breakdowns could be done for other causes, such as heating and electrical distribution and lighting equipment. While such an analysis is beyond the scope of this report, breaking out the causes in this way can help better target prevention strategies.

Area of origin, victim's location, and fire spread

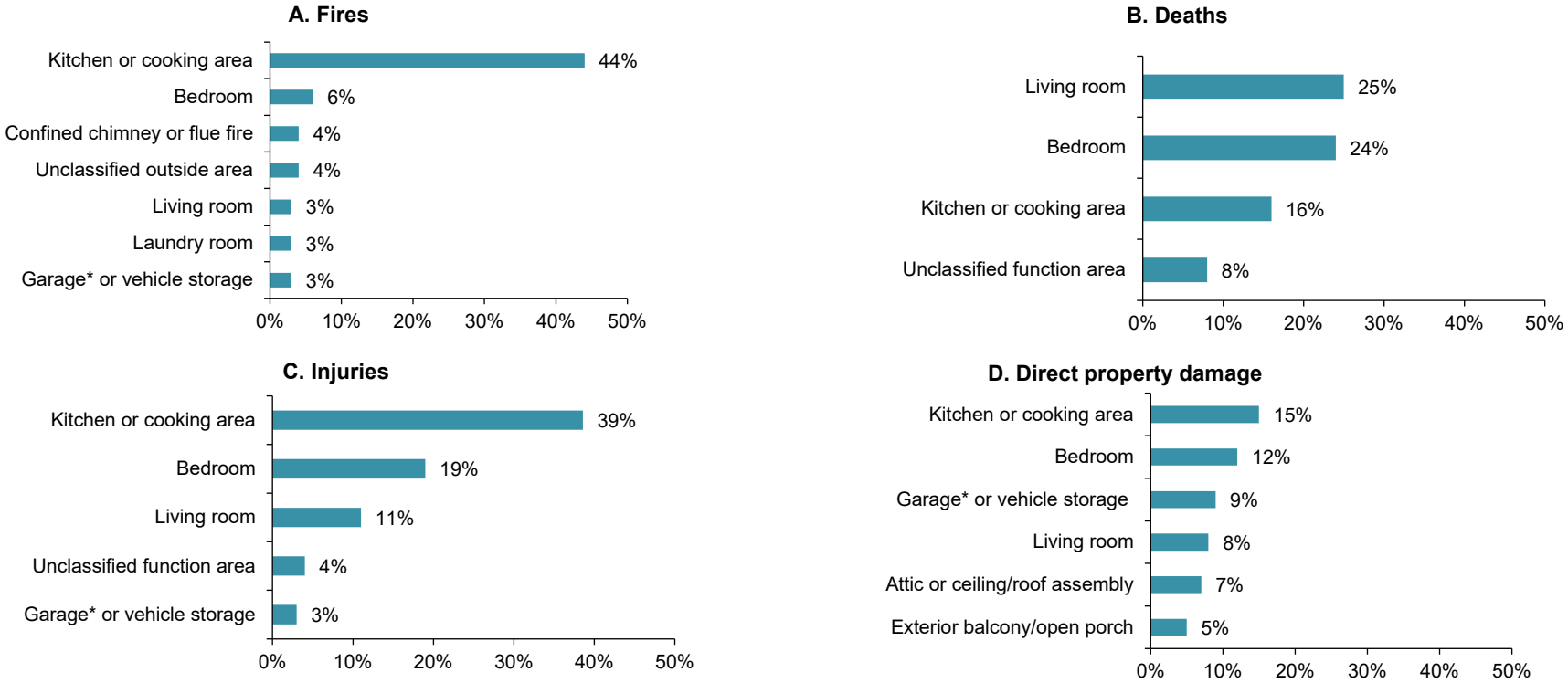
As cooking is the leading cause of home fires and fire injuries, it is not surprising that the kitchen was the leading area of origin for home fires and injuries. See Figure 10. Apartment or multifamily housing fires were more likely to start in the kitchen (69 percent) than were fires in one- or two-family homes (33 percent).

Roughly two-thirds of home fire deaths (65 percent) and injuries (69 percent) were caused by fires in just three rooms: living rooms, bedrooms, and kitchens.

While these three areas were among those associated with the highest property damage, home fires starting in garages (3 percent), in attics or ceiling roof assemblies/concealed spaces (3 percent), and on exterior balconies or open porches (2 percent), all caused a disproportionate amount of property damage. Fires in these spaces may be less likely to be discovered when the fire is small than fires in interior living spaces.

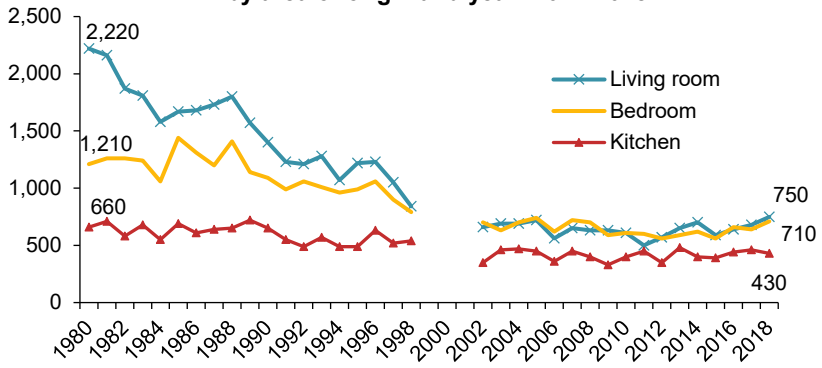
Figure 11 shows that deaths from fires originating in living rooms fell more sharply than deaths from fires starting in bedrooms and kitchens. Historically, the largest number of fire deaths result from fires starting in living rooms. The differences between the three leading areas of origin for home fire deaths have decreased over time, with deaths from bedroom fires sometimes slightly exceeding the number of those resulting from fires starting in living rooms.

Figure 10. Leading areas of origin in home structure fires: 2014–2018



*Does not include fires with property use coded as a residential garage.

Figure 11. Home fire deaths by area of origin and year: 2014-2018



Compared to home fire deaths in 1980–1984, the average number of deaths in 2014–2018 resulting from fires starting in the living room fell 65 percent, deaths from fires beginning in the bedroom fell 47 percent, and deaths from fires starting in the kitchen dropped 33 percent.[v]

Fires in the living room were more likely to cause death than fires in other areas. Despite the drop in deaths in all three locations, the average death rate per 1,000 reported fires was twice as high for fires that started in either the living room or bedroom in 2014–2018 compared to 1980–1984. Today's reported kitchen fires were less likely to result in death than such fires in the earlier period. See Figure 12.

In a 2012 article, UL's Stephen Kerber described experimental burns comparing living-–room-style spaces containing items common to modern homes and rooms with legacy furnishings. He discovered flashover times decreased from roughly 30 minutes with legacy furnishings to roughly five minutes with the modern items.[8]

Half of the fatalities from fires in the living room and two-thirds of the bedroom fire fatalities were in the room or area of origin when the fire started, compared to almost two of every five kitchen fire deaths. Roughly two-thirds of the fatal fire victims who were in the area of origin were also involved in the ignition. See Figure 13.

Both fatal and non-fatal fire victims who were not in the area of origin when the fire started were more likely to be sleeping than were other fire victims, The percentage of fatalities in sleeping victims was higher than the percentage of non-fatal injuries. Fatal fire victims were also more likely to have been impaired by alcohol or physically disabled than were those who were non-fatally injured. See Figure 14.

Figure 12. Deaths per 1,000 fires in leading areas of origin: 1980–1984 vs. 2014–2018

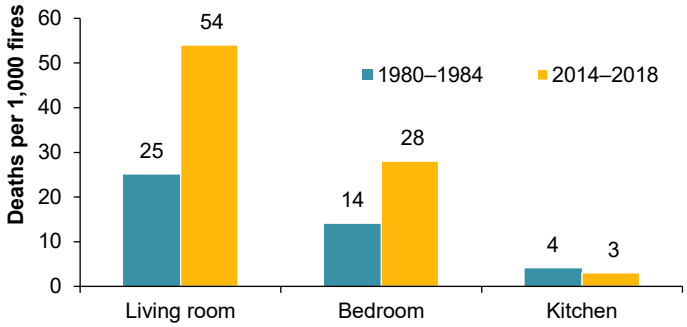
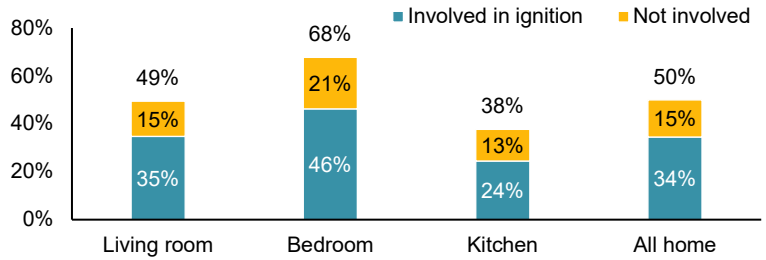


Figure 13. Home fire deaths in area of origin by involvement in ignition and area of origin 2014–2018



[v] Version 5.0 of NFIRS was introduced in 1999 and was adopted gradually over the next several years. Due to the instability of the estimates for 1999-2001—the transition years to NFIRS 5.0—estimates for these years are not shown in the graphs.

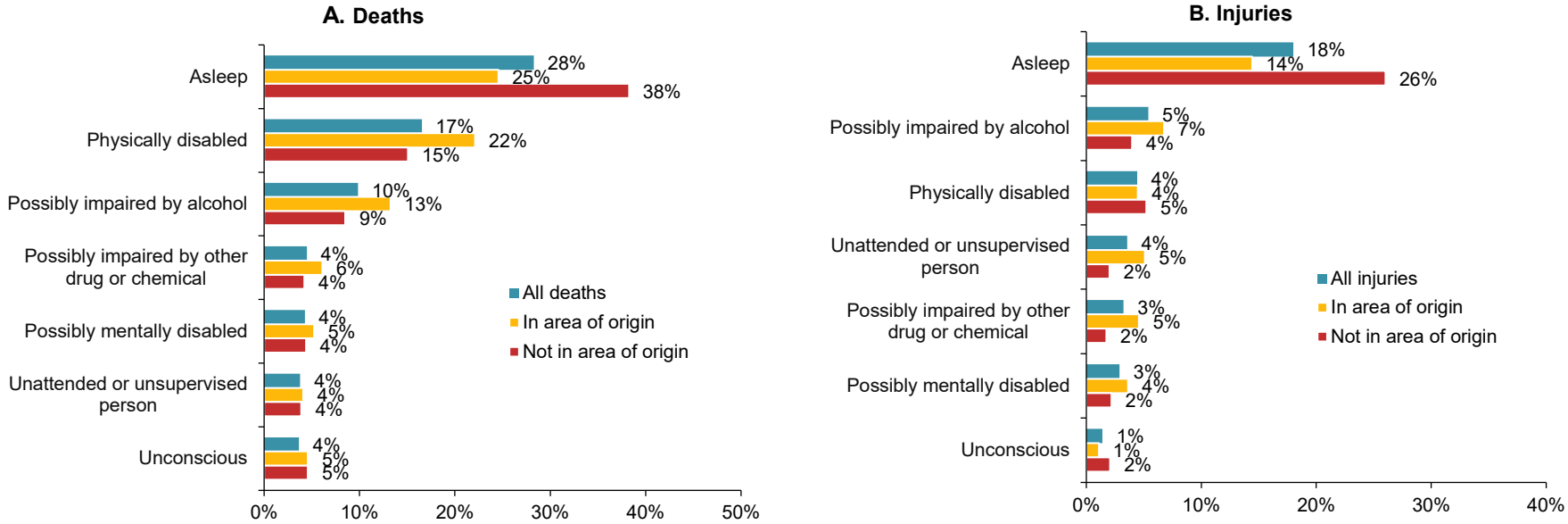
Analysis of the NFIRS data indicates that 10 percent of the home fire fatalities were possibly impaired by alcohol and 4 percent were possibly impaired by other drugs or chemicals. Some individuals may have had both drugs and alcohol in their bloodstream. NFIRS data comes from the fire service and are likely to underestimate the role of alcohol and drugs.

Autopsy results indicate more frequent alcohol involvement than the NFIRS reports would suggest. Autopsies are routinely done on Minnesota fatal fire victims. Alcohol or drug use was a factor in 35 percent of the total Minnesota fire deaths in 2016, in 26 percent of the state's fire deaths in 2017, and in 49 percent of the deaths in 2018.[9]

Alcohol is widely cited as a contributing factor to fatal fires. Many factors correlate with each other. Two articles cited data from the *National Survey on Drug Use and Health.* Higgins and his colleagues reported that in 2011–2013, 64 percent of people who abused or were dependent on illicit drugs were current smokers, as were 44 percent of those who abused or were dependent on alcohol, 32 percent of those with a mental illness, and 33 percent of those with incomes below the poverty level.[10] Weinberger and her colleagues reported that 38 percent of people with any alcohol use disorder (AUD) were current smokers in 2016 compared to 16 percent with no AUD. The percentage of smokers increased with AUD severity to 52 percent with severe AUD.[11]

A review of European and Australian research indicates that many factors associated with US home fires and casualties are seen in other industrialized countries as well. In England, cooking caused roughly half of the reported unintentional dwelling fires and associated injuries from April 2018 to March 2019. Smoking materials caused only 8 percent of the fires but 34 percent of the deaths,[12] compared to 5 percent of the fires and 23 percent of the deaths in the US in 2014–2018. While the percentages may differ, the patterns are similar.

Figure 14. Home fire deaths and injuries by victim proximity to fire origin and NFIRS "human factor" contributing to injury: 2014–2018



Some risk factors are better documented in other countries than in the US. In the US, fatal fires in which possible mental impairment was indicated were typically cases of self-immolation. Dementia, developmental disabilities, and possible mental illnesses were not specifically captured. Smoking, alcohol, advanced age, physical disabilities, and fires that begin in the living room or bedroom are common factors in fatal fires in the US and abroad. These many shared factors suggest that their experience with other factors may be relevant to the US.

Sesseng, Storesund, and Steen-Hansen found that being a smoker, having a mental illness, and being alone at the time of a fire were common factors for victims of all ages in Norwegian fatal fires. Known substance abuse and being under the influence were more common in victims under 67 years of age, while older adult victims were more likely to have had reduced mobility and/or cognitive impairment.[13]

Australian researchers Xiong, Bruck, and Ball compared factors associated with residential fire death or survival. Many differences were found between survivors and fatal fire victims. Those who died were significantly more likely to have:

- Taken psychotropic or sedative drugs
- Been in a fire started by a discarded cigarette
- Been living alone
- Been more than 70 years of age
- Been asleep at the time of the fire
- Been in the room of origin at the time of the fire
- Consumed alcohol before the fire
- Been suffering from a physical illness

Fires that began in the living room or bedroom were also more likely to result in death, as were fires in homes that were moderately to severely cluttered or in a state of disrepair. Pre-existing disabilities and mental illnesses were associated with a greater likelihood of death. The risk was also higher in rental housing.[14]

Giebułtowicz and her colleagues analyzed 263 dwelling fire death cases from the Mazowieckie region of Poland in 2003–2011. They found that roughly three out of every five victims were in the room of origin with about half found near upholstered furniture that had burned. Of the victims, 70 percent were men. Of those men, 70 percent had consumed alcohol. Living alone was another risk factor.[15]

Although the US has little statistical information on the role of cognitive decline, mental illness, hoarding, or living alone as factors in fire deaths, anecdotal evidence suggests that they also play a role in US fire deaths. Although it is not as well documented in the US, it is likely that living alone increases the risk of fire death in the US as well.

Some clusters can be found in the statistics for US home fire fatalities. In an analysis of 2011–2015 home fire deaths and injuries, smoking was the leading cause of home fire deaths overall.[16] However, this was true only in the age group of 45–84 years old. Among those 85 and older, cooking caused the most deaths.

Of the cooking fire deaths in 2011–2015, 18 percent were caused by the 1 percent of such fires that began with clothing ignition. Four out of five cooking/clothing ignition victims were at least 65 years old, suggesting that reduced mobility may have played a role.

Of the people who died in intentional home fires, 58 percent were between 35–64 years of age. Two-thirds of the victims of all fatal intentional home fires were male.

Fire causes by area of origin

The leading causes of fires in living rooms and in bedrooms in 2014–2018 differ greatly from those in kitchen fires, and they are much more varied. See Figure 15. Electrical distribution and lighting equipment was the leading cause of fires in living rooms, the second leading cause of fires in bedrooms, and the third leading cause of fire death in both rooms. Smoking materials

were the leading cause of fire death in living rooms and the second leading cause in bedrooms.

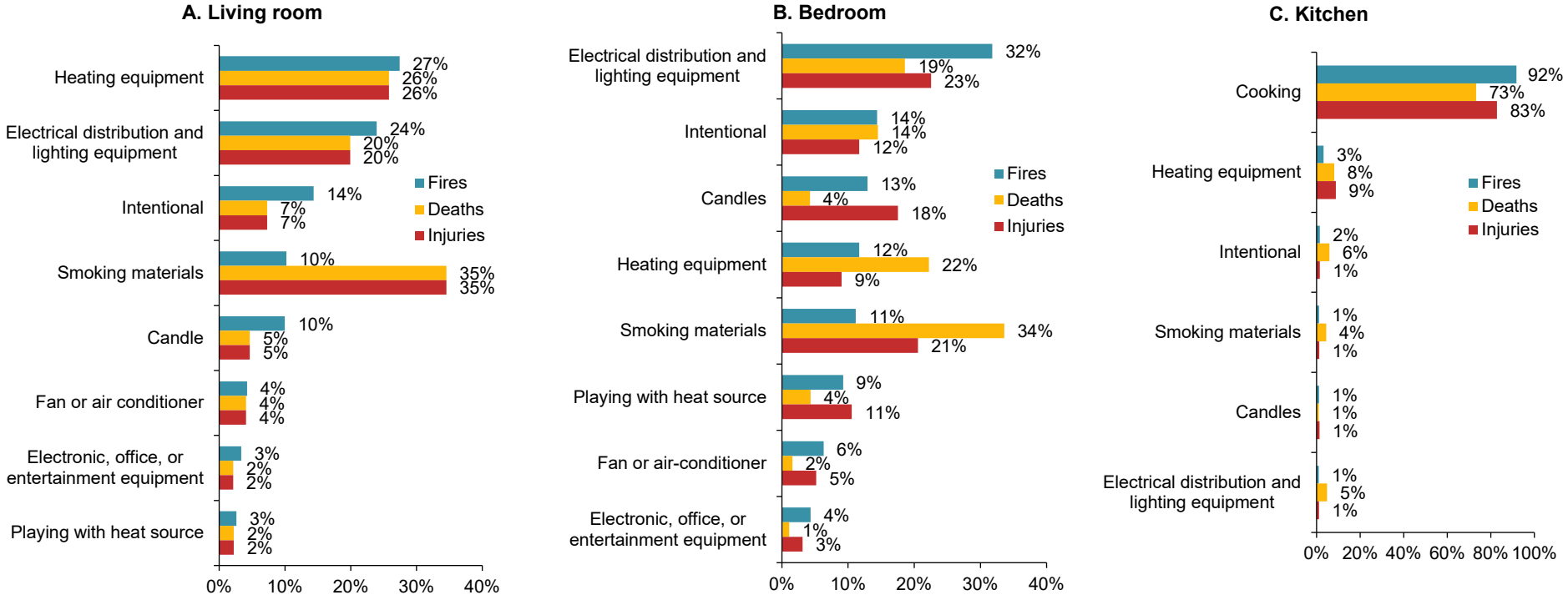
Nine percent of bedroom fires were started by someone playing with a heat source, such as a lighter, candle, or matches. According to the 2014 NFPA report *Playing with Fire,* 39 percent of the home structure fires caused by fire play in 2007–2011 started in the bedroom. Bedroom fires caused 54 percent of the deaths and 57 percent of the injuries that resulted from home fire play.[17] If a fire started in a bedroom with no smoke alarm and the door was closed, serious injury could occur before the smoke reached a hallway smoke alarm. Interconnected alarms with bedroom coverage would sound and alert others in the home early in the fire's development.

While space heater fires are an issue in both living rooms and bedrooms, fireplace and chimney fires are a particular issue in living rooms. Most fireplaces and woodstoves are in these rooms.

As noted earlier, cooking is by far the leading cause of home fires, and, predictably, the cause of most kitchen fires and fire casualties. According to the 2020 NFPA report, *Home Cooking Fires,* more than one-quarter of the fatal home cooking fire victims in 2014–2018 (28 percent) were asleep at the time of injury. In addition, 52 percent of the non-fatal cooking injuries occurred when someone tried to fight the fire themselves.[18]

Although heating equipment was the second leading cause of kitchen fire deaths, the heating equipment most often involved was a heating stove. It is likely that some of these were kitchen ranges that had been miscoded.

Figure 15. Leading causes of fires and casualties in leading areas of home structure fires: 2014–2018



Leading items first ignited in home structure fires

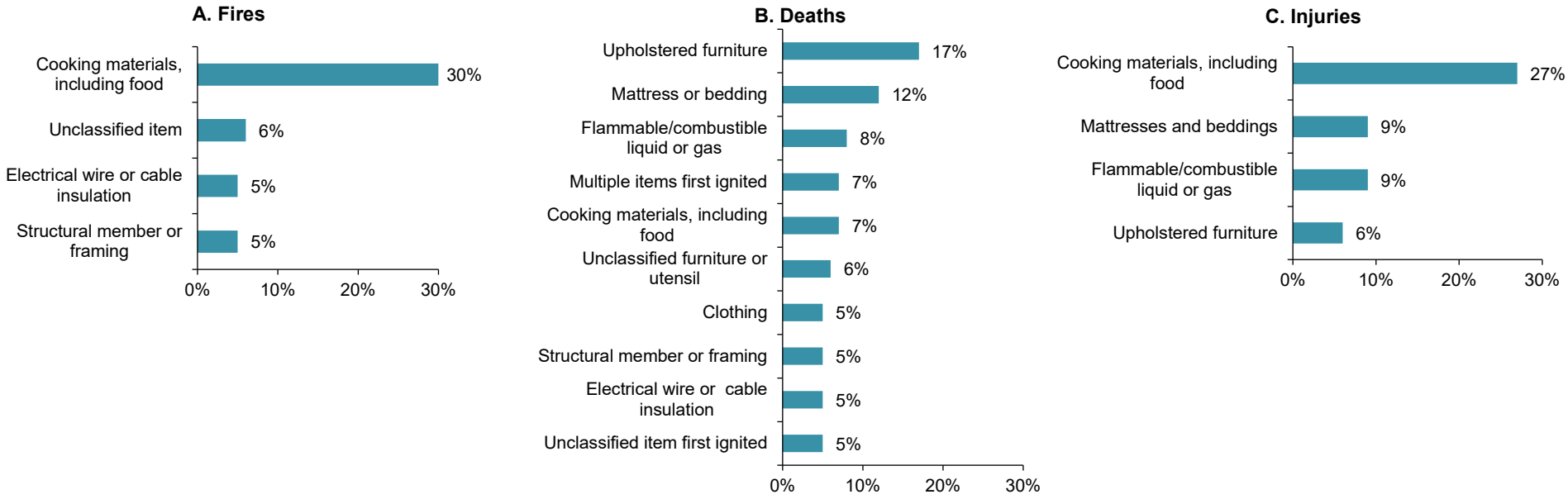
With cooking being the leading cause of home fires, it is not surprising that cooking materials, including food, are the leading items first ignited in home fires and in fires that caused injuries. A wider variety of items first ignited is seen with home fire deaths. See Figure 16. The two leading items in home fire deaths are upholstered furniture and mattresses or bedding,[vi] consistent with the leading areas of origin associated with fire deaths.

While upholstered furniture was first ignited in an average of only 5,000 reported home fires per year (1 percent), these incidents caused 430 deaths (17 percent), 670 injuries (6 percent), and $245 million in direct property damage (3 percent) annually. The 8,300 fires per year that began with mattresses or bedding (2 percent) caused an annual average of 320 deaths (12 percent), 1,010 injuries (9 percent), and $271 million in direct property damage (4 percent) annually.

The average number of deaths from home fires beginning with the ignition of upholstered furniture in 2014–2018 was 65 percent lower than the 1980–1984 average. Deaths from fires starting with mattresses or bedding were down 58 percent from the earlier period. See Figure 17.

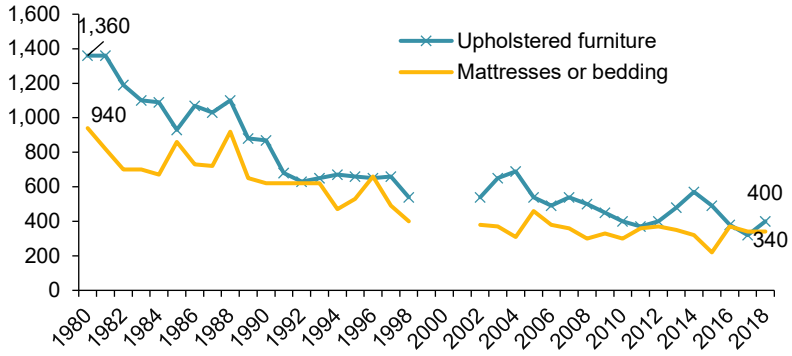
Although the death toll from upholstered furniture and mattresses or bedding has fallen, the death rates per 1,000 reported fires beginning with these items in 2014–2018 is more than twice as high as in 1980–1984. See Figure 18.

Figure 16. Leading items first ignited in home structure fires: 2014–2018



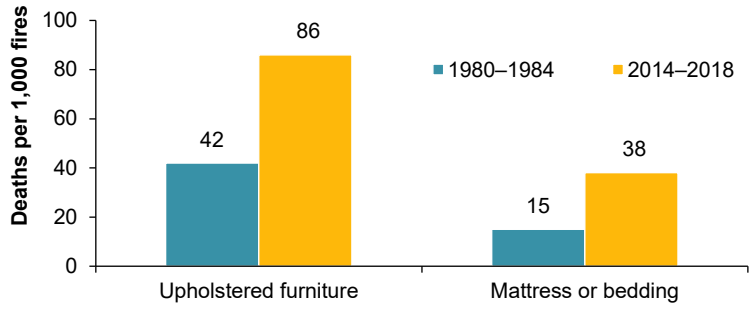
[vi] NFIRS groups upholstered sofas, chairs, and vehicle seats into one code choice for item first ignited. NFPA combines two NFIRS item first ignited codes—a) mattress or pillow and b) bedding, blanket, sheet, or comforter—into the category of mattress or bedding. Some furniture, such as folded mattresses covered with upholstery fabric (futons), traditional sleep sofas with pullout mattresses, and upholstered furniture with cloth protectors or throw-style furniture covers, could potentially be coded as either upholstered furniture or mattresses and bedding.

Figure 17. Home fire deaths from fires starting with upholstered furniture and mattresses or bedding by year



Fires starting with upholstered furniture and mattresses or bedding are relatively low-frequency, high-consequence fires. On average, one of every 12 upholstered furniture fires and one of every 26 mattress or bedding fires in 2014-2018 resulted in death.

Figure 18. Deaths per 1,000 fires that began with uphostered furniture or mattresses and bedding 1980–1984 vs. 2014–2018



Leading heat sources associated with home fire deaths and injuries

Three categories of heat sources—operating equipment; smoking materials; and lighters, candles, or matches (small open flames)—combined initiated fires that caused three-quarters (74 percent) of the total home fire deaths and injuries.

Considerable attention has been paid to cigarettes and small open flames as ignition sources. While fires started by operating equipment such as ranges, heating equipment, dryers, and extension cords often have a human element, the role of operating equipment should not be overlooked. Automatic shutoffs and other safety features can protect against predictable human error.

The category of operating equipment includes the following four NFIRS heat source codes:

- Radiated or conducted heat from operating equipment.
- Sparks, embers, or flames from operating equipment.
- Arcing, and
- Unclassified heat from powered equipment.

During 2014–2018, some type of operating equipment was the heat source in an average of 182,900 home structure fires per year (51 percent). These fires caused an annual average of 1,060 deaths (40 percent); 5,810 injuries (53 percent); and $2.9 billion in direct property damage (40 percent).

During the same period, lighters, candles, or matches were the heat source in an average of 25,400 home structure fires per year (7 percent). These fires caused an annual average of 290 deaths (11 percent); 1,470 injuries (13 percent); and $551 million in direct property damage (8 percent).

As discussed previously, smoking materials, including cigarettes, pipes, cigars, and undetermined smoking materials, were the heat source in an annual average of 16,800 home fires (5 percent) and caused an annual

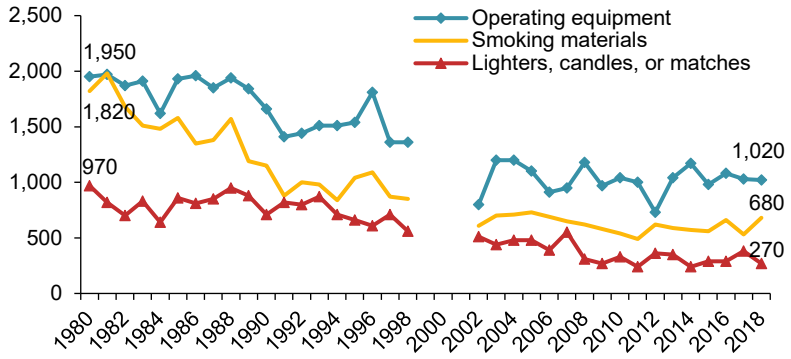
average of 590 deaths (23 percent); 1,050 injuries (10 percent); and $492 million in direct property damage (7 percent).

It is likely that some portion of the fires said to have been started by hot embers or ashes (24,000 fires; 90 deaths; 390 injuries; and $457 million in direct property damage) were actually started by smoking materials. Investigations performed by the Consumer Product Safety Commission (CPSC) into 19 fatal residential fires in 2017 in which the NFIRS heat source was hot ember or ash found that 13 were started by cigarettes. CPSC did not investigate non-fatal fires with a heat source code of hot ember or ash. NFPA has not made these adjustments in its analyses.

Consequently, it appears the estimates of fires started by smoking materials and the associated losses in this report likely underrepresent the true size of the smoking material fire problem.[19] It is also likely that some portion of the smoking material fires were started by marijuana cigarettes. Unfortunately, such incidents cannot be identified using the coded data in NFIRS.

Figure 19 shows that deaths from fires started by smoking materials and by lighters, candles, or matches have fallen more than deaths from fires started by small open flames or operating equipment.

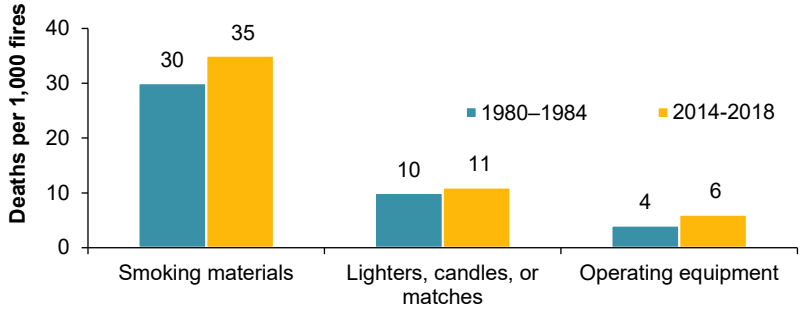
Figure 19. Home fire deaths by selected heat source and year



According to the Centers for Disease Control and Prevention (CDC), 33.2 percent of adults smoked cigarettes in 1980.[20] In 2017, 16.7 percent smoked combustible tobacco products and 14 percent smoked cigarettes, specifically.[21] The annual average death toll from fires started by smoking materials was 65 percent lower in 2014–2018 than it was in 1980–1984, while deaths from fires started by small open flames (lighters, candles, or matches) were down 63 percent compared to the earlier period. The death toll from fires started by operating equipment was 44 percent lower than in 1980–1984.

The increase in death rates per 1,000 fires was not as large for these three heat source categories as compared to those for fires starting in furnishings. This suggests that the heat source is not driving the increased death rates for upholstered furniture or mattresses and bedding. See Figure 20.

Figure 20. Deaths per 1,000 fires for selected heat sources 1980–1984 vs. 2014–2018



Preventing fires and fire losses

In a 2020 article, Nilson and Bonander describe five possible points of intervention to prevent fire deaths: "reduce heat; stop ignition of first object; hinder fire growth; initiate evacuation; and complete evacuation."[22] The first two prevent the fire while the last three come into play after the fire starts. Smoke detection or another method of discovery can alert occupants to act—to evacuate or hinder the fire. Fire growth may be limited by depriving the fire of oxygen, operating sprinklers, or other means of fire control. The

ability to complete evacuation depends on occupant characteristics, the location and size of the fire, and the availability of an exit.

Safer products can prevent many fires from starting by reducing or shutting off a heat source or separating a potential fuel from a heat source. Considerable progress has been made to make products safer, but more is left to be done. Equipment and other product redesigns or automatic shutoffs on heating equipment, cooking equipment, and irons can mitigate human error and improve safety. Such changes may be the most effective and inexpensive approach to fire prevention.

The CPSC issues product safety standards and recalls of unsafe consumer products and collects reports about such products from the public. Reports of unsafe consumer products can be made to the CPSC at saferproducts.gov. Site users can also search for recalls and other reports on unsafe products.

The earlier a fire is discovered, the more time there is to deal with it while it is still very small or to escape. Figure 21 shows that a smoke alarm was present in three-quarters of the reported home fires (74 percent), substantially less than the 96 percent of homes with smoke alarms that were reported in telephone surveys done for NFPA.[23] However, almost three of every five home fire deaths resulted from fires in which either no smoke alarm was present (41 percent) or at least one alarm was present but did not operate (16 percent). To better understand smoke alarm reliability, it is helpful to exclude fires with no smoke alarms at all and fires in which the smoke did not reach the device. Smoke alarms operated in 89 percent of the fires in which they were present and the fire was considered large enough to activate them. Of the deaths in such fires, 73 percent took place in homes with operating smoke alarms.

People who are in the room of fire origin may be intimately involved with the ignition. Their clothing or the furniture they are sitting or lying on may catch fire. Even if they are not intimately involved, being in the room where the fire starts dramatically reduces escape time. Others may have difficulty responding quickly.

Home fire sprinklers can control a fire until help arrives, even when the occupants are unable to act. Table A shows that sprinklers are highly reliable and effective. Unfortunately, they were present in only 7 percent of the reported fires. See firesprinklerinitiative.org for more information.

Although smoke alarms and sprinklers are often considered separately, the greatest safety is found when both are present. Figure 22 shows that the death rate per 1,000 reported home fires is lowest when both hardwired smoke alarms and sprinklers are present. Whether or not the systems operated is not considered here. There are several things to consider when interpreting the data.

Figure 21. Smoke alarm status in home structure fires: 2014–2018

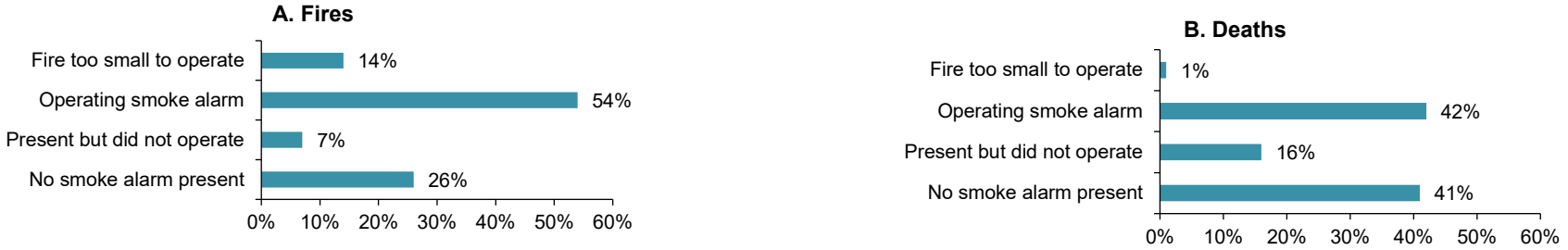


Table A. Sprinkler Systems in Reported Home Structure Fires[vii]
2014–2018 Annual Averages

Share of reported home fires with sprinklers present	7%
When present, operating in fires large enough to activate	95%
When operating, effective in controlling fire	97%
When present and fire large enough, operated *and* effective	92%
Civilian deaths per 1,000 reported fires	
Without automatic extinguishing equipment	7.5
When sprinklers were present regardless of operation	1.1
Percent reduction	86%
Civilian injuries per 1,000 reported fires	
Without automatic extinguishing equipment	31
When sprinklers were present regardless of operation	24
Percent reduction	21%
Firefighter injuries per 1,000 reported fires	
Without automatic extinguishing equipment	50
When sprinklers were present regardless of operation	12
Percent reduction	76%
Average loss per fire	
Without automatic extinguishing equipment	$19,500
When sprinklers were present regardless of operation	$8,500
Percent reduction	56%

Because these rates are based on reported fires only, they are dependent on which fires were reported. It is likely that the lifesaving impact of battery-powered smoke alarms is underestimated. CPSC's survey of unreported residential fires found that 97 percent of home fires were handled without the fire department.[24] Discovering a fire when it is in its earliest stages increases the likelihood of the occupants being able to handle it themselves. Monitored alarm systems that automatically generate a fire department response when smoke detectors are activated typically have hardwired smoke detectors. This results in a larger share of minor fires being reported in structures with hardwired alarms. In many cases, the occupants were alerted and dealt with the fire before the fire department arrived. Sprinklers were more likely to be present in properties with monitored smoke detection systems than in properties without them.

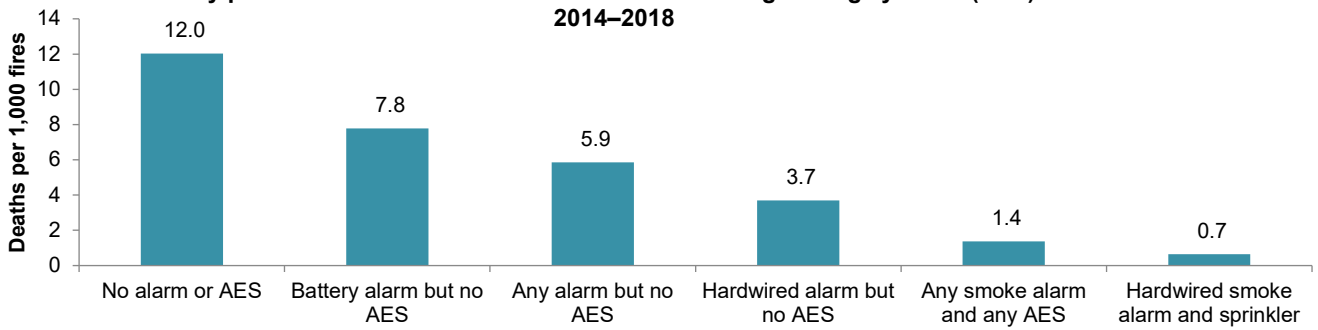
Some problems cannot be addressed by the fire service or fire protection alone. Norwegian researchers Gjøsund, Almkov, and Halvorsen cited research indicating that a majority of fatal fire victims in Norway had some kind of vulnerability, such as drug or alcohol use, physical or cognitive challenges, low socio-economic status, or another situation that would make an individual less likely to discover a fire in its early stages or to mitigate or safely evacuate from a fire. Vulnerability can be reduced if the individual lives in a home that addresses these issues. They wrote "… A person's actual vulnerability is determined by a municipality's organizational and economic capability to provide appropriate organizational and technological measures."

Fire prevention is only one of the many challenges these individuals face. Although municipalities sometimes map user needs for home care services, they often don't consult with the fire service. A lack of resources can make interagency coordination less likely. Little guidance exists on how different agencies should work together. Regulations are also generally sector-specific.[25]

Firefighters often provide emergency medical services, assist after falls, and notice dangers before a fire occurs. In many cases, they identify problems that are beyond the scope of fire department capabilities. Assistance from social services, public health departments, or other organizations is often needed. As in Norway, different areas of the US provide services in different ways. Navigating the systems to find the appropriate resources is often difficult.

[vii] Fires in properties that were under construction or that had partial sprinkler systems or systems that did not operate because they were not in the fire area are not included in this table. Fires with NFIRS confined fire incident types 113–118 were excluded from the calculations of operation and effectiveness because of the scarcity of usable data.

Figure 22. Average fire death rate per 1,000 reported home structure fires by presence of smoke alarms and automatic extinguishing systems (AES) 2014–2018



Methodology

Supporting tables for all the fires in homes, one- or two-family homes, and in apartments or multifamily homes are available online here.

Unless otherwise specified, the statistics in this analysis are national estimates of fires reported to US local fire departments and exclude fires reported only to federal or state agencies or industrial fire brigades. Estimates are projections based on the detailed information collected in the US Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's annual Fire Experience Survey. Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in the calculations of national estimates.

In general, any fire that occurs in or on a structure was considered a structure fire, even if the fire was limited to contents and the building itself was not damaged. Only civilian (non-firefighter) casualties are included in this analysis. For more information, see *How NFPA's National Estimates Are Calculated for Home Structure Fires*.

The causes shown are those that are well-defined and have clear prevention strategies or have historically been of interest. The data comes from several NFIRS data elements. Double counting is possible.

For more information see *NFPA's Methodology and Definitions Used in "Leading Causes of Structure Fires" Tables*.

Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property damage to the nearest million dollars. Estimates of zero may be true zeroes or may have been rounded to zero. Percentages were calculated on unrounded estimates. Annual averages do not include inflation adjustments.

Acknowledgments

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the NFIRS and the annual NFPA Fire Experience Survey. These firefighters are the original sources of the detailed data that makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

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

To learn more about research at NFPA, visit nfpa.org/research.
Email: research@nfpa.org
NFPA No. USS12

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