



## Smoke Alarms in U.S. Home Fires

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### Executive Summary

Smoke alarms have become such a common feature in U.S. homes that it is easy to take them for granted. Reporters tell of fires in which blaring smoke alarms alerted sleeping occupants to danger. These devices alert countless others to fires just as they are starting. Telephone surveys, including 2008 and 2010 surveys conducted for the National Fire Protection Association (NFPA) by Harris and a Consumer Product Safety Commission’s (CPSC’s) 2004-2005 survey found that 96-97% of the surveyed U.S. households reported having at least one smoke alarm. Based on these results, almost five million households still have no smoke alarms.

This report provides the latest information about smoke alarms in home fires<sup>1</sup> reported to local fire departments in the U.S. Most estimates in this report were derived from the U.S. Fire Administration’s (USFA’s) National Fire Incident Reporting System (NFIRS) and the NFPA’s annual fire department experience survey.

#### Three out of five home fire deaths resulted from fires in properties with no or no working smoke alarms.

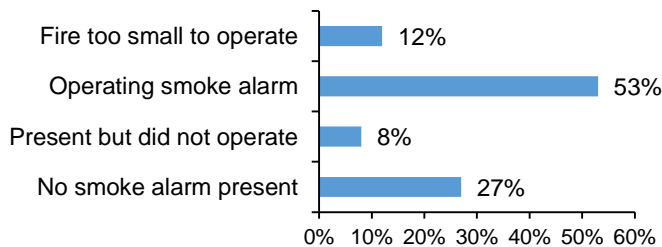
In 2009-2013, smoke alarms, including those in fires too small to activate them, operating smoke alarms, and those that failed to operate, were present in almost three-quarters (73%) of reported home fires and sounded in more than half (53%) of the home fires reported to U.S. fire departments.

- Almost two out of five (38%) home fire deaths resulted from fires in which no smoke alarms were present at all.
- One of every five (21%) deaths was caused by fires in properties in which smoke alarms were present but failed to operate.
- Smoke alarms operated in fires that caused two out of five (40%) home fire deaths.
- One percent of the deaths resulted from fires that were too small to activate the smoke alarm.

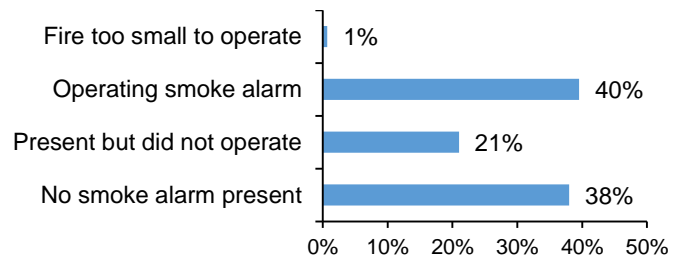
When smoke alarms were present in fires considered large enough to activate them, they operated 87% of the time.

### Reported Home Structure Fires and Fire Deaths by Smoke Alarm Performance 2009-2013

#### A. Fires



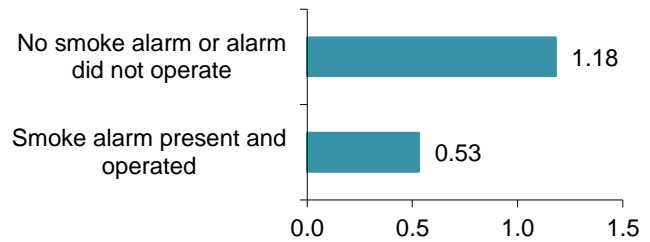
#### B. Deaths



<sup>1</sup> The term “home fires” includes fires in one- or two-family homes, including manufactured housing, and apartment or multi-family housing.

**The risk of dying in reported home structure fires is cut in half in homes with working smoke alarms.** The death rate per 100 reported home fires was more than twice as high in homes that did not have any working smoke alarms (1.18 deaths per 100 fires), either because no smoke alarm was present or an alarm was present but did not operate, as it was in homes with working smoke alarms (0.53 per 100 fires).

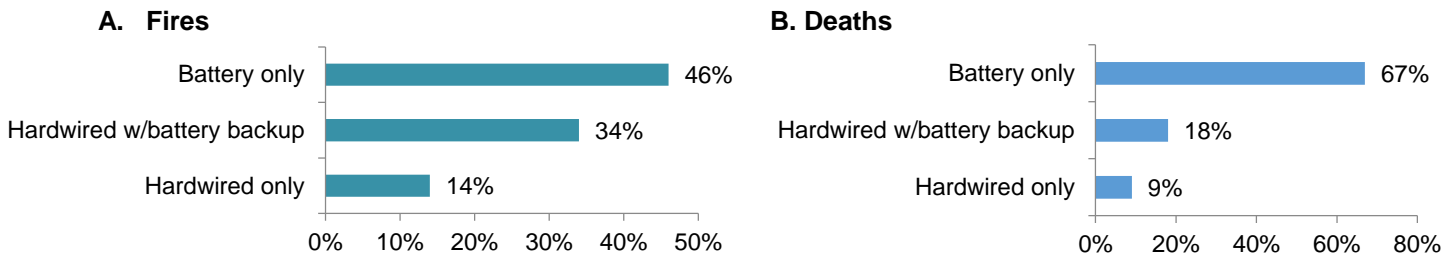
**Death Rate per 100 Reported Home Fires by Smoke Alarm Status: 2009-2013**



The death rate from reported fires in homes that had at least one smoke alarm (0.59 deaths per 100 fires) was 40% lower than in homes that had no smoke alarms at all (0.98 deaths per 100 fires). Installing smoke alarms is the first step. It is important to be sure they are working.

**Hardwired smoke alarms were more likely to have operated than battery-powered alarms.** When smoke alarms were present in reported home fires, they were battery-powered in 46% of the incidents and two-thirds (67%) of the associated deaths. Hardwired smoke alarms (with or without battery backup) were present in 48% of such fires and more than one-quarter (28%) of the associated deaths.

**Leading Smoke Alarm Power Sources in Home Structure Fires with Smoke Alarms Present 2009-2013**



When present, hardwired smoke alarms (with and without battery backup) operated in 94% of the fires considered large enough to trigger a smoke alarm. Battery-powered alarms operated 80% of the time.

**Most homes still have smoke alarms powered by batteries only.** In the 2011 *American Housing Survey* (AHS), three out of five (61%) respondents who reported having smoke alarms said their alarms were powered by batteries only, one-third (33%) said their alarms were powered by electricity and batteries, and 7% had alarms powered by electricity only.<sup>2</sup> For many years, NFPA 101®, *Life Safety Code*®, and other codes have required smoke alarms in new construction to be hardwired with battery backup. Yet the AHS found that in 30% of homes less than five years old that had working smoke alarms, the smoke alarms were powered by battery only.

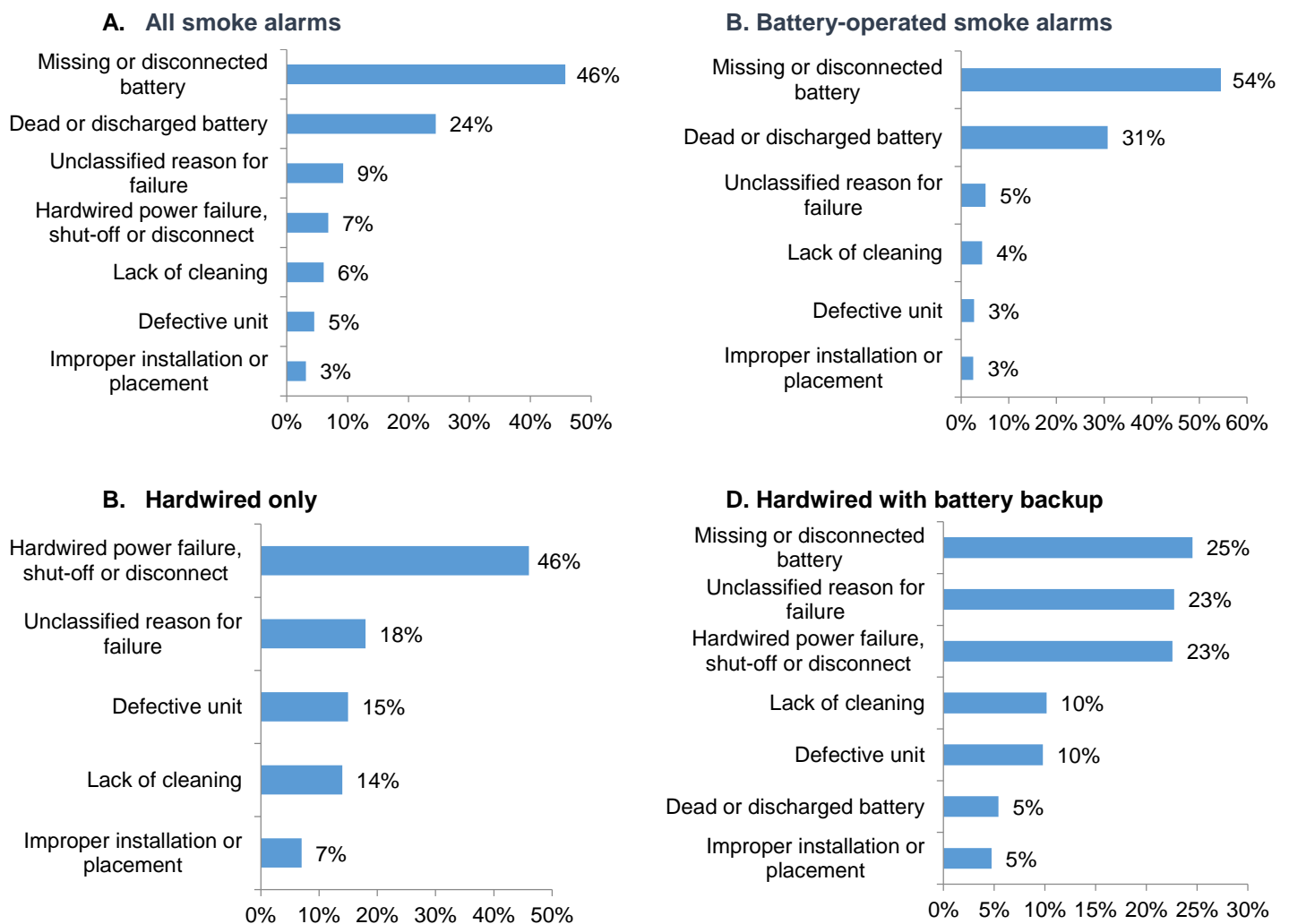
<sup>2</sup> Percentage calculations exclude unknown data.

In 2009-2013, the death rate per 100 reported fires was 2.5 times as high in fires with smoke alarms powered by batteries as it was in fires with hardwired smoke alarms. To be effective, the codes must be adopted and enforced.

**Disconnected or non-working power sources were leading reasons for smoke alarm failures.** When smoke alarms should have operated but did not do so, it was usually because batteries are missing, disconnected or dead. In more than half (54%) of reported home fires with battery-powered smoke alarm failures, batteries were missing or disconnected. Almost one-third (31%) of these smoke alarm failures were due to dead batteries. A power-failure, shut-off or disconnect was the leading failure reason for failures of hardwired only smoke alarms (46%), and the second leading cause for failures of hardwired alarms with battery backup (23%).

People are most likely to disable smoke alarms because of nuisance activations. Sometimes the chirping to warn of a low battery is interpreted as a nuisance alarm.

**Reason Smoke Alarms Did Not Operate in Home Structure Fires Considered Large Enough to Activate 2009-2013**



**Nuisance alarms due to cooking are common but can be prevented.** Half of the households surveyed in a 2010 Harris Poll done for NFPA reported they had smoke alarms in their kitchen. Two out of every five (43%) households reported their smoke alarms had gone off at least once in the past year. Almost three-quarters (73%) said the activation was due to cooking. Eight percent mentioned low battery chirps.

If a smoke alarm in the kitchen is sounding too often, the problem could be solved by moving the smoke alarm. [NFPA 72®, National Fire Alarm and Signaling Code®](#) states that unless designed specifically for the area, all smoke alarms should be at least 10 feet away from cooking appliances. If space constraints make it necessary to have a smoke alarm within 10-20 feet of the kitchen stove, either a photoelectric alarm or an alarm with a hush feature that can be temporarily silenced without disabling the alarm should be used.

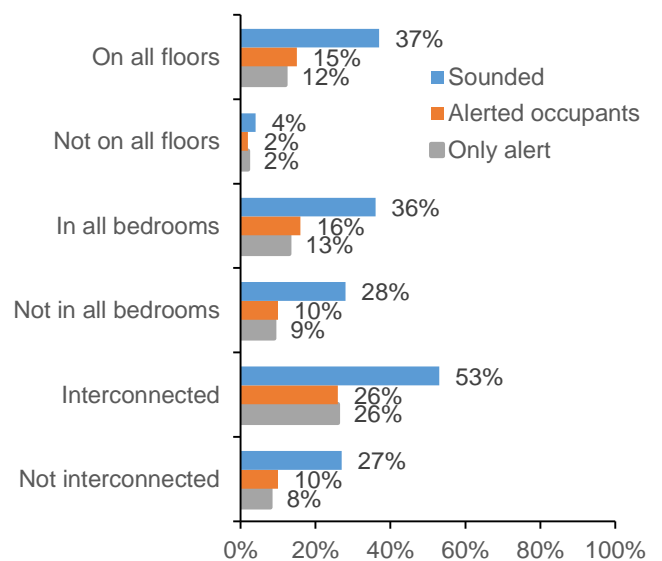
**Most homes do not yet have the protection required in recent editions of NFPA 72®.** [NFPA 72®, National Fire Alarm and Signaling Code®](#) and [NFPA 101®, Life Safety Code®](#), require new and existing one- and two-family dwellings to have smoke alarms in every bedroom, outside each sleeping area, and on every level. For best protection, they should also be interconnected so that when one sounds, they all sound. Hardwired smoke alarms are more likely to be interconnected, although battery-powered wireless interconnected alarms are available. New homes should have hardwired smoke alarms. A 2010 Harris Interactive survey done for the NFPA found that roughly two out of every five households had smoke alarms in all bedrooms. Only one-quarter of all homes had interconnected smoke alarms.

**CPSC study shows the importance of interconnected smoke alarms in providing early warnings.**

In a CPSC survey of households with any fires, including fires in which the fire department was not called, interconnected smoke alarms were more likely to operate and alert occupants to a fire.<sup>3</sup> People may learn about a fire without hearing a smoke alarm. In some cases, they hear the smoke alarm at the same time they notice flames or smoke. In others, only the smoke alarm provided the initial alert.

- When smoke alarms (interconnected or not) were on all floors, they sounded in 37% of fires and alerted occupants in 15%.
  - When smoke alarms were *not* on all floors, they sounded in only 4% of the fires and alerted occupants in only 2%.

**Smoke Alarm Performance and Effectiveness in CPSC's 2004-2005 Survey of Unreported Residential Fires**



<sup>3</sup> Michael A. Greene and Craig Andres. [2004-2005 National Sample Survey of Unreported Residential Fires](#). U.S. CPSC, July 2009.

- When smoke alarms were in all bedrooms, they sounded in 36% of the fires and alerted occupants in 16%.
  - When smoke alarms were *not* in all bedrooms, they sounded in 28% of the fires and alerted occupants in 10%.
- In homes that had interconnected smoke alarms, the alarms sounded in half (53%) of the fires and alerted people in one-quarter (26%) of the fires.
  - Smoke alarms that were not interconnected sounded in 27% of the fires and alerted people in 10%.

**To be effective, a smoke alarm’s warning must be heard or received.** Another CPSC study found that a closed lightweight door reduced the volume of a smoke alarm signal from another room by 10 to 20 decibels. The signal was weakened by roughly 20 decibels each level it traveled.<sup>4</sup>

In her literature review on sleep and waking to fire alarms,<sup>5</sup> Dorothy Bruck concluded that louder signals are needed when significant background noise is present. She also found that arousal thresholds vary significantly from individual to individual. Sleep deprived adults are less likely to wake to a smoke alarm, as are young children and people under the influence of alcohol, marijuana or sleep inducing medication.

The higher frequency hearing loss that often accompanies aging reduces the probability that older adults will wake to a smoke alarm. The 2013 edition of [NFPA 72®, National Fire Alarm and Signaling Code](#), requires audible notification appliances used in bedrooms for those with mild to severe hearing loss to produce a low frequency signal. Another provision requires tactile notification appliances in addition to strobes for individuals with moderately severe to profound hearing loss. These provisions take effect immediately upon adoption of the code.

**People who died in fires with working smoke alarms often had characteristics or circumstances that made escape more difficult.** Compared to deaths resulting from fires in which no smoke alarms were present or alarms were present but did not operate, victims of fatal fires with working smoke alarms were

- More likely to have been in the room or area of origin and even more likely to have been in the area of origin and involved in ignition;
- More likely to have been at least 65 years old;
- More likely to have had a physical disability;
- More likely to have been fighting the fire themselves; and
- Less likely to have been sleeping when fatally injured.

**Progress has been made but more work is needed.** The households with smoke alarms that don’t work now outnumber the households with no alarms by a substantial margin. Any program to ensure adequate protection must include smoke alarm maintenance. In the 2010

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<sup>4</sup> Arthur Lee. [The Audibility of Smoke Alarms in Residential Homes](#), Bethesda, MD: U.S. CPSC, September 2005, revised January 2007.

<sup>5</sup> Dorothy Bruck, “The Who, What, Where and Why of Waking to Fire Alarms: A Review,” *Fire Safety Journal*, Volume 36 (2001), pp. 623-639.

Harris poll, only one in five respondents reported testing their smoke alarms at least once a month. Although most homes have at least one smoke alarm, many do not have an alarm on every level. It is easy to forget that a smoke alarm's sole function is to sound the warning. People need to develop and practice escape plans so that if the alarm sounds, they can get out quickly. Because smoke alarms alert occupants to fires that are still relatively small, some people try to fight these fires themselves. Unfortunately, some of these attempts are unsuccessful due to either rapid fire spread or inappropriate methods of fire control. Meanwhile, precious escape time is lost.

**Go to NFPA's Smoke Alarm Central for safety tips, videos and more.**

NFPA's 2015 Fire Prevention Week (FPW) theme is "Hear the beep where you sleep. Every bedroom needs a working smoke alarm." Find general safety tips in English and in Spanish, instructions for installing smoke alarms, and more at [nfpa.org/smokealarms](http://nfpa.org/smokealarms).