

# **Door Position Messaging Strategies: Implications for Detection and Notification**

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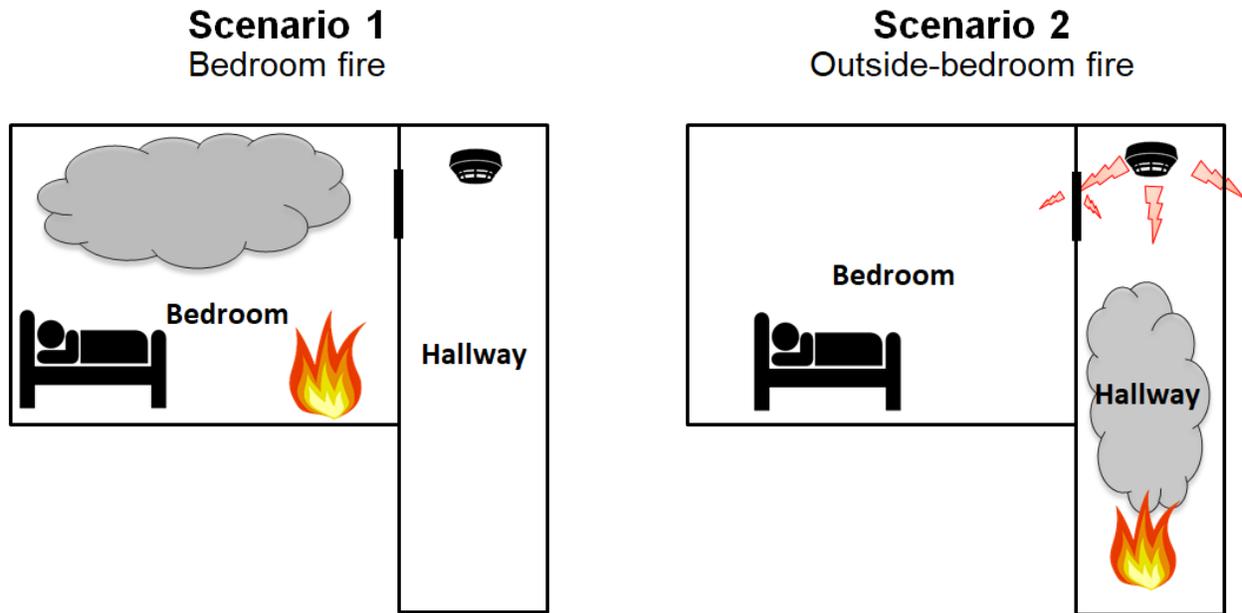
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## **Abstract**

Fire safety is achieved not only by formulation of sound protection strategies, but also by delivering proper messaging to the public about these strategies. Recent messaging efforts have focused on encouraging the public to close bedroom doors during sleeping hours. The closed door message, conveyed by pamphlets and other paper materials, websites, and fire videos, demonstrates that the closing of a bedroom door can delay and minimize the fire and smoke conditions in the bedroom, allowing for more time for escape (UL FSRI, 2019). The topic of what message to deliver to the public regarding closing a bedroom door for fire safety has generated considerable debate in the fire safety community. While this recommendation appears to be sound technically and may save lives, there are concerns that this could adversely affect the detection and occupant notification in some fires and could possibly do more harm than good from a societal standpoint. This project was undertaken by the Fire Protection Research Foundation to assess the effect of closing a bedroom door on the detection and notification of fires. There are two primary situations where the closing of the bedroom door could have a detrimental effect on the life safety of occupants from a detection and notification perspective:

1. A fire originates in an occupied bedroom. The closed bedroom door allows products of combustion, including smoke, toxic gases and heat, to build up in the bedroom resulting in an untenable environment for those in the room. If a smoke alarm is not present in the bedroom, the closed bedroom door will also delay detection of the fire by preventing smoke from reaching an alarm outside of the closed bedroom. This is shown visually on the left of Figure 1.
2. A fire originates outside of an occupied bedroom. If an alarm is not present inside and outside the bedroom, and interconnected, the closed bedroom door prevents adequate audibility of the smoke alarm to occupants in the closed bedroom. This is shown visually on the right of Figure 1.

The message of closing a bedroom door at night for enhanced fire safety is not new. While perhaps not highlighted to the extent it has been in recent years, it is mentioned in America Burning, the Report of the Commission on Fire Prevention and Control (1973). It specifically states to "Sleep with bedroom doors closed. In the event of a fire, you will gain precious minutes to escape". It also is mentioned in the annex for NFPA 74 in the 1974 edition where it is stated that "Location of the smoke detector outside the bedrooms presupposes that the occupants sleep with their doors shut to provide a barrier to the smoke thus gaining additional seconds for escape." Current existing messaging often pairs the message of closing the bedroom door with messaging about planning and practicing fire escape plans as well as having smoke alarms inside and outside the bedrooms and having them interconnected. Nevertheless, instances were identified where the importance of the closed bedroom door was picked up by other media outlets, but the need for smoke alarms to be installed inside and outside the bedrooms and interconnected was omitted or altered.



**Figure 1.** Scenarios of concern regarding a closed bedroom door at night. Fire dynamics/detection scenario (left) and notification/audibility scenario (right).

The potential magnitude of the problem related to the above scenarios was assessed. Major changes to residential smoke detection and alarm requirements were introduced in the 2007 edition of NFPA 72, *National Fire Alarm and Signaling Code*. In the residential chapter, smoke alarms were required in all sleeping and guest rooms, outside each bedroom and on every level of the unit compared to previous editions where alarms were only required on each level and outside sleeping areas. The alarms were also required to be interconnected in 2007. As of 2019, all US states have adopted the 2007, or newer, edition of NFPA 72 for new construction which should therefore follow the requirement for interconnected alarms inside as well as outside bedrooms (NFPA, 2019). Therefore, all future home construction in the US should conform to the requirements of having interconnected smoke alarms in all bedrooms and in the hallways. Nevertheless, it was discovered that despite code requirements for smoke alarms inside and outside the bedrooms and interconnection being present in NFPA 72 for over 10 years, fewer than half of U.S. residences have smoke alarms in the bedroom and fewer than a quarter have interconnected alarms (Ahrens, 2019). Therefore, the potential magnitude of this problem is large.

The fire science literature was analyzed to evaluate the effect of a closed bedroom door on the number of adverse outcomes that may result from fires originating in the bedroom (Bukowski et al., 2008; NFPA Task Group, 2009). In addition, calculations on the effect of a closed bedroom door on the audibility of a smoke alarm were used to estimate the number of adverse outcomes caused by occupants not waking to the alarm (Butler, Bowyer, and Kew, 1981; Halliwell and Sultan, 1986; Bruck and Ball, 2005). The increased non-success rates from these situations were combined with statistics on smoke alarm presence, the prevalence and origin of residential fires, and occurrences of fatalities in residential fires to quantify the overall number of expected adverse outcomes due to closing the bedroom door (Ahrens, 2018; Ahrens, 2019). These were compared with the number of fire fatalities where a closed bedroom door may offer a benefit based on fire incident statistics. Overall, it was found that the increase in the number of adverse outcomes from a closed bedroom door were relatively small and that the potential benefit of closing a bedroom door was far greater. Specifically, 2–4% of residential fires may have an adverse outcome and 5-7% of fatalities may result from a closed bedroom door at night. This is to be compared with approximately 40% of residential fire fatalities that may benefit from the

closed bedroom door at night. The overall finding was that there was a net societal gain from a cost/benefit perspective to closing the bedroom door at night, and that the number of adverse outcomes due to detection and notification issues was minimal. Therefore, on a purely technical basis, the concerns over the detection and notification aspects of the closed bedroom door should not preclude delivering this message to the public.

Despite the finding that closing a bedroom door should offer a societal gain from a cost/benefit perspective, concerns were raised during a workshop about the impact of delivering this message to the public (Hutchinson, 2019). Specifically, concerns that the public cannot effectively process additional messages beyond those that are already delivered regarding smoke alarms and escape plans were mentioned. It was also mentioned that the public may opt to follow the closed bedroom door recommendation instead of following smoke alarm installation and maintenance messaging, which could result in a net cost to society which outweighs the benefit. These concerns may or may not be justified. Indeed, statistics have shown that in 40% of residential fire fatalities, no smoke alarm was present at all and in another 17%, the smoke alarm was non-working, likely due to being disabled by occupants (Ahrens, 2019). Nevertheless, these concerns are based on the development, delivery and impact of educational messages and are therefore beyond the scope of this analysis. What this analysis does indicate is that the concerns over situations where a closed bedroom door may hinder detection and notification of a fire are likely not justified and alone should not be cited as a reason to not deliver the closed bedroom door message. This analysis concludes that on a purely technical basis, closing the bedroom door at night is likely to save lives and provide a net benefit to the public.

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