THE NIST REPORT ON RESIDENTIAL STRUCTURE FIRE

The study is the first to quantify fire service lifesaving and firefighting operations for a low-hazard residential structure including the effects of changes in crew size, arrival time, and stagger on rescue and suppression effectiveness.[i]

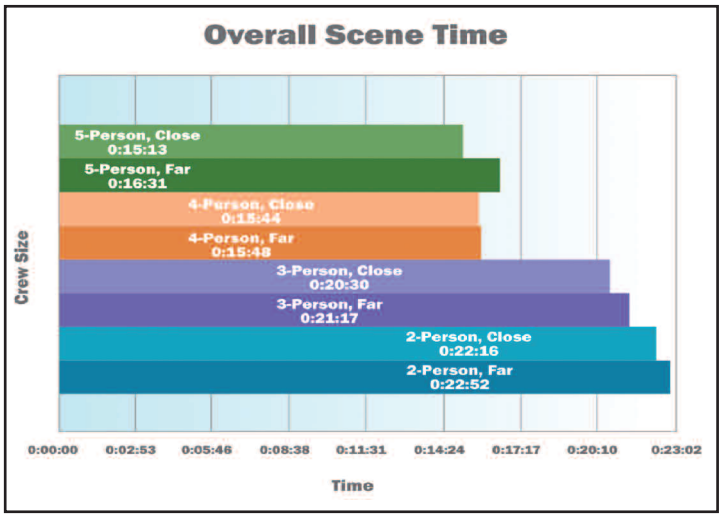
The study included more than 60 controlled fire experiments, both in our large fire laboratory and at the custom low-hazard residential burn building constructed at the Montgomery County Training Academy. The results of the study provide quantitative data to fire chiefs and public officials responsible for determining safe staffing levels, appropriate station locations, and necessary funding for community and firefighter safety.

Overall, the results of the study show that that the number of fire service crew members in each company responding to a fire in a 2,000 square-foot, two-story structure had a substantial effect on the crew's ability to protect lives and property.

Three key findings related to firefighter performance:

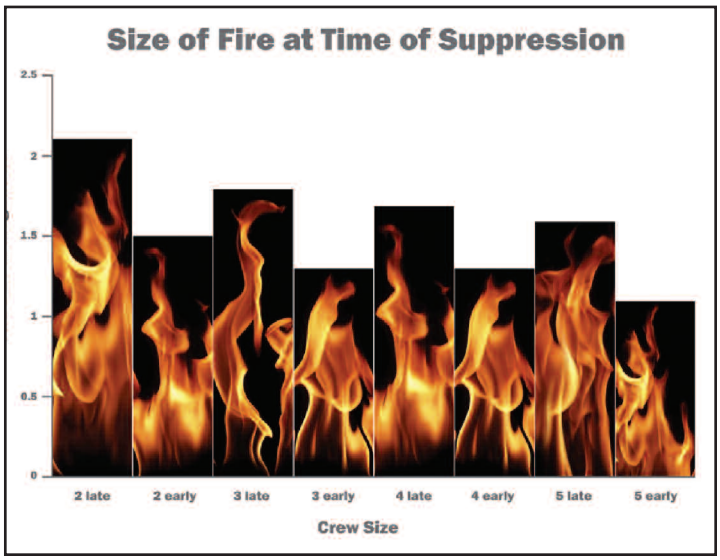
Overall Scene Time

Four- and five-person crews were able to complete the 22 essential firefighting and rescue tasks in a residential setting 30 percent faster than two-person crews and 25 percent faster than three-person crews. (See poster) Overall scene time is the time that it takes the firefighters to complete all 22 tasks. The overall scene time measure is critical to the fire crew's ability to complete their work safely and return to the station in order to be available for the next fire call. In addition, firefighter crews that complete several of the tasks simultaneously, rather than consecutively, are able to complete all tasks and are less fatigued. It is important to note that previous studies have documented significant benefits for five-person crews for medium- and high-hazard structures, particularly in urban settings, unlike the low-hazard residential fire scenario examined in this study.



Time to Water Application

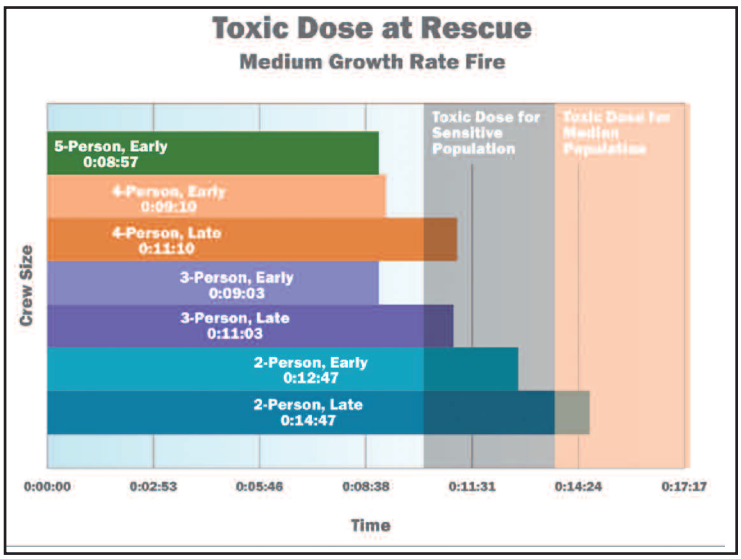
Fire risks grow exponentially. Each minute of delay is critical to the safety of occupants and firefighters and is directly related to property damage. Results show that five-person crews were able to apply water to the fire 22 percent faster than two person crews. Four-person crews were able to apply water to the fire 16 percent faster than two-person crews and 6 percent faster than three-person crews. What this means for firefighter safety is that two-person crews arriving later to the scene faced a fire about 2.1 megawatts in size. On the other end of the spectrum, five-person crews arriving earlier to the scene faced a fire about half as big at 1.1 megawatts. For context, a 1 megawatt fire would be a fully-involved upholstered chair burning at its peak. A 2 megawatt fire, however, would be sufficient to produce near-flashover conditions in the 12 by 16 foot room of fire origin used in our experiments. Facing a fire of twice the intensity greatly increases the danger to the firefighters and increases the likelihood that the fire will spread beyond the room of origin.



Rescue Effectiveness

To estimate how various crew sizes would affect the exposure of occupants to toxic gases, slow-, medium-, and fast-growth rate fires were simulated using NIST's Fire Dynamic Simulator software. The simulation assumed an occupant unable to escape on their own from an upstairs bedroom with the bedroom door open.

Occupant exposures were calculated both when firefighters arrive earlier to the scene, representing crews from fire stations nearby the burning structure, and those arriving later, representing crews arriving from more distant locations. The simulations showed that for a medium-growth fire, two-person crews would not be expected to complete essential tasks in time to rescue occupants from exposures to toxic gases that would incapacitate sensitive populations such as children and the elderly. Two-person crews arriving later would also likely find a significant portion of the general public incapacitated by the time of rescue. The simulations for early arriving five-, four- and three-person crews show that they would likely be able to locate and rescue an occupant before sensitive populations would be incapacitated.



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