Evaluation of Three Smoke Detector Promotion Programs


Context: Seventy percent of U.S. residential fire deaths occur in homes without a working smoke detector. To help prevent residential fire deaths, many programs have distributed or installed detectors in unprotected homes. Because persons receiving a detector may not install it and because detector batteries require annual replacement, the enduring effectiveness of these programs may be questioned.

Objective: We evaluated the long-term functional status of smoke detectors distributed to high-risk households in eight areas of Minnesota, Cherokee County (North Carolina), and Oklahoma City (Oklahoma).

Design: Cross-sectional.

Setting: Home visits were made to check the detectors that were distributed 3 to 4 years earlier.

Participants: Randomly selected households from the three detector promotion programs.

Main Outcome Measure: At least one working smoke detector.

Results: Participation rates ranged from 72% to 82%. The percentage of evaluation households with at least one working detector ranged from 58% in Oklahoma to 73% in North Carolina. In 76% of households with nonworking detectors, the batteries were either missing or disconnected. When batteries in nonworking detectors were replaced, 83% of the detectors regained function.

Conclusions: Future programs should consider distributing detectors that do not require annual battery changes or find effective ways to ensure that batteries are routinely replaced. Programs should also provide each household with the number of detectors needed to meet the most current recommended standard of the National Fire Protection Agency. The evaluation’s participation rates support the practicality of unannounced home visits to evaluate home injury prevention programs in high-risk groups.


Fires and burns are the fourth leading cause of unintentional injury death in the United States, and residential fires account for 80% of these deaths.\(^1,2\) In 1995, residential fires caused approximately 3,700 deaths and 19,125 injuries.\(^2\) Although the rate of residential fire deaths has declined by nearly 40% over the past two decades, particular groups of people continue to be disproportionately affected. Death rates are highest among adults aged 60 years and older, children younger than 5 years old, people with low socioeconomic status, and those living in substandard housing or mobile homes.\(^1,3,4\) About 70% of residential fire deaths occur in homes without a working smoke detector.\(^5\)

A working smoke detector reduces the risk of death from residential fire by at least 50%.\(^6,7\) Despite the proven effectiveness of detectors, about 30% of U.S. households do not have a working smoke detector.\(^8\)

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The use of detectors may be even lower in some poorer neighborhoods. A 1992 national survey found that households with incomes of less than $15,000 were about 60% less likely to have a working detector than homes with higher incomes. A survey conducted in an inner-city neighborhood in Memphis found that 52% of households had a working detector.

To reduce residential fire deaths, hundreds of fire departments and community organizations across the nation have provided smoke detectors to households in need. Relatively few of the detector promotion programs have been formally evaluated. Even less is known about the long-term effectiveness of these programs.

During 1990 and 1991, the National Center for Injury Prevention and Control (NCIPC), Centers for Disease Control and Prevention, funded smoke detector promotion programs in Minnesota, North Carolina (Cherokee County), and Oklahoma (Oklahoma City). The goal of the programs was to deliver detectors to households without working detectors. In 1994, NCIPC funded an evaluation of the three programs. A sample of households from each program was visited to check the detectors and interview household members about detector maintenance. The objectives of the evaluation were to (1) estimate the proportion of program households with at least one working detector 3 to 4 years after the distribution; (2) describe the condition of nonworking detectors; and (3) describe the association between reported detector battery replacement and having a working detector. This paper summarizes the programs and the 1994 evaluation findings.

Summary of Smoke Detector Programs

**Minnesota**

During 1990 and 1991, the Minnesota Department of Health’s Home Safety Checklist Program conducted home visits in the city of St. Paul, five rural communities, and two Indian reservations. Public health professionals performed walk-through inspections of homes of young children and older adults to identify and correct potential injury hazards, including testing every smoke detector. Detectors and batteries were replaced or installed, as needed. Of the 1,300 homes visited, 338 (26%) received a detector; households that received a detector were eligible for the 1994 evaluation.

**North Carolina**

The Sounds of Security (SOS) detector promotion program was conducted during 1990 and 1991 in Cherokee County, a rural county in the western tip of North Carolina. The county health department, the local senior center, and the county’s 15 volunteer fire departments collaborated to distribute detectors to county residents who reported not having a working detector. In total, the program distributed 851 detectors to 702 households; 569 detectors (67%) were installed. Two distribution methods were used. First, the program targeted county residents aged 65 years and older on limited incomes. A local media campaign encouraged older residents who needed a detector to call their volunteer fire department. Fire fighters made home visits to those who called to install detectors and explain how to maintain them. Between August 1990 and June 1991, 569 detectors were installed in 420 homes. In late 1992, the fire fighters revisited a random sample of 30% of the 420 participating homes to test the detectors and replace the batteries. Information on functional status of the detectors in the revisited households was not available for this summary.

From April to June 1991, the program conducted several detector give-aways at the county health department and other public sites such as supermarkets. Any county resident who reported not having a working detector was eligible. One smoke detector per household was provided along with installation instructions; installation was the responsibility of the participants. A total of 282 detectors were distributed. Later that summer, follow-up telephone interviews were conducted with 237 (84%) of the 282 households that received detectors at the public give-aways. Of the households contacted, 182 (77%) reported that the detector had been installed.

**Oklahoma**

The Lifesavers Residential Fire and Injury Prevention Program targeted four ZIP Codes in south Oklahoma City. This area had experienced the highest rate of residential fire deaths in the state in recent years. During the first month of the give-away program (May 1990), four methods of distributing detectors were tested to see which one reached the greatest number of households in the target area. The most successful method, canvassing door-to-door, was used exclusively in the remaining 6 months of the program. City fire fighters, Oklahoma State Health Department personnel, and volunteers from the American Red Cross went door-to-door distributing one smoke detector to each household that reported not having a working detector. In total, the program distributed 10,100 detectors to 9,291 households. Participants were given simple written instructions on detector installation and maintenance, fire prevention, and escaping a fire. Canvassers installed 917 (9%) detectors at the request of participants.

From June to December 1991, uniformed city fire fighters revisited 5,617 (60%) of the participating households to test the detectors. Fifty-one percent of revisited households had a properly installed and work-
ing detector. A replacement battery was provided for each detector, and new detectors were provided, when needed. For households that did not receive a follow-up visit, replacement batteries were left at the front door along with instructions for installation. In 1992 and 1993, postcards reminding residents to change the detector batteries were mailed to all program households.

Methods

All English-speaking households that had received a detector were eligible for the evaluation regardless of whether the current residents had lived in the house when the detectors were distributed. Homes that had been vacated or destroyed, homes that had been converted to businesses, and mobile homes that had been moved away since the detectors were distributed were ineligible. The evaluation questionnaire was modeled after the instrument used in the 1992 national Smoke Detector Operability Survey. It included questions about the location and functional status of each smoke detector in the home, residents' battery replacement practices, and household characteristics associated with residential fire death.

A self-weighted stratified sample of addresses was selected from each detector promotion program using the equal probability of selection method. The Cherokee County (North Carolina), and Oklahoma City sampling frames were stratified by whether the household received a follow-up contact in the year after the detectors were distributed. Because the Minnesota program distributed detectors in eight areas of the state, its sampling frame was stratified by those areas.

Interviewers were hired and supervised by a health department staff member at each of the three evaluation sites. They attended a 1-day training session to practice interview skills and procedures for testing detectors before they began making home visits. Home visits were made from April through November 1994. Interviewers arrived unannounced and made up to three attempts to contact each household. They checked each detector by spraying it with aerosol testing smoke and pressing the test button. For battery-operated detectors, if the battery had not been replaced in the last 6 months, a new battery was installed. Nonworking detectors were replaced. Lastly, homes were inspected to see if each separate sleeping area and each additional story of living space had a properly located and working detector, as recommended by the National Fire Protection Association. Households with fewer than the recommended number of properly located and working detectors were provided new detectors; most of the new detectors were installed.

The data were analyzed using the household as the unit of analysis. For households with more than one working detector, test results from the first working detector were analyzed. For households with only non-working detectors, results from the first nonworking detector were used. Data from each of the three sites were first stratified by the sampling strata, and the proportion of households with at least one working detector within each stratum was compared. Because the proportions did not vary significantly by stratum for any of the three programs (P > 0.05), the data were not weighted to reflect the stratified sampling design. The proportion of households with at least one working detector was estimated for each of the three programs, and 95% confidence intervals were calculated. The effect of battery replacement practices and household characteristics on having a working detector were examined using unadjusted risk ratios.

Results

Evaluation visits were attempted to 641 addresses, and 436 interviews were completed. Seventy-one (11%) of the sampled addresses were ineligible because they were not residential households (e.g., dwelling was unoccupied), and one household was ineligible because no one in the home spoke English (Table 1). At least three homes had been destroyed by fire. Response rates (number of completed interviews/number of addresses sampled minus number of ineligible addresses) ranged from 72% to 82%.

Overall, 76% of the homes visited during the evaluation were still occupied by the people who had lived there when the detectors were distributed (Table 2). In 95% of those households, a resident remembered receiving a program detector. Minnesota had the highest proportion of households with preschool-aged children, and North Carolina had the highest proportion of households with older adults, reflecting the high-risk age groups that the programs targeted. Tobacco smoking was common across all sites, with 34% to 62% of households reporting at least one smoker. Use of supplemental heating was highest in North Carolina. The most common supplemental heat sources were portable electric or kerosene heaters and wood-burning stoves.

Overall, 88% of the households had at least one detector and 64% had at least one working detector at follow-up (Table 3). Ninety-three percent of the households with detectors had battery-operated detectors; of households with battery-operated detectors, 72% had at least one working detector (64% in Minnesota, 74% in Oklahoma, and 76% in North Carolina). Common conditions among nonworking detectors included missing batteries, dead batteries, and disconnected batteries. In 26% of the households with nonworking detectors, residents reported that they forgot to replace the battery; in 22%, residents did not know why the detec-
tor did not work; and in 21%, residents reported having removed the battery because of nuisance alarms. After the batteries in nonworking battery-operated detectors were replaced, 83% of the detectors regained function, leaving 79% of Minnesota households, 93% of North Carolina households, and 73% Oklahoma households with at least one functioning detector.

After all of the nonworking detectors were either restored to working condition or replaced, 49% of Minnesota households and 25% of North Carolina and Oklahoma homes still had at least one sleeping area or additional story without a properly located, working detector. The discrepancy in detector coverage between Minnesota and the other two sites was mostly due to differences in the types of housing. Nearly half of Minnesota homes had a basement or a second story, whereas 75% of North Carolina and 97% of Oklahoma homes had only one level. Additional smoke detectors were provided free of charge and installed at participants’ request.

Households that reported having replaced the battery in the past year were more likely to have a working detector (Table 4). Unadjusted risk ratios for having replaced the battery ranged from 1.9 in Minnesota to 3.1 in North Carolina. Reporting an annual income of $10,000 or greater was also modestly associated with having a working detector in all three programs, with risk ratios ranging from 1.3 to 1.8.

Discussion

This evaluation is one of the first to examine the long-term functional status of detectors distributed by detector promotion programs. It was conducted in both urban and rural sites, with participation rates of 72% to 82%. These rates support the practicality of unannounced home visits to evaluate programs to prevent home injuries in high-risk groups.

In total, the three programs distributed detectors to 10,331 households that reported not having a working detector; 7,934 (77%) were delivered directly to the homes. Three to four years later, about 95% of Minnesota households had at least one functioning detector. Unadjusted risk ratios for having replaced the battery ranged from 1.9 in Minnesota to 3.1 in North Carolina. Reporting an annual income of $10,000 or greater was also modestly associated with having a working detector in all three programs, with risk ratios ranging from 1.3 to 1.8.

Table 1. Summary of participation in the 1994 smoke detector evaluation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Minnesota (n = 338)</th>
<th>Cherokee County, North Carolina (n = 702)</th>
<th>Oklahoma City, Oklahoma (n = 9,291)</th>
<th>Total (n = 10,331)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program households</td>
<td>117</td>
<td>210</td>
<td>146</td>
<td>313</td>
</tr>
<tr>
<td>Addresses sampled for evaluation</td>
<td>181</td>
<td>210</td>
<td>250</td>
<td>641</td>
</tr>
<tr>
<td>Completed interviews</td>
<td>117</td>
<td>146</td>
<td>173</td>
<td>436</td>
</tr>
<tr>
<td>Ineligible addresses</td>
<td>19</td>
<td>31</td>
<td>19</td>
<td>72</td>
</tr>
<tr>
<td>No one found at home</td>
<td>16</td>
<td>12</td>
<td>31</td>
<td>59</td>
</tr>
<tr>
<td>Refused interview</td>
<td>25</td>
<td>9</td>
<td>10</td>
<td>44</td>
</tr>
<tr>
<td>Incomplete interview</td>
<td>4</td>
<td>12</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Evaluation participation rate</td>
<td>72%</td>
<td>82%</td>
<td>76%</td>
<td>77%</td>
</tr>
</tbody>
</table>

aHouseholds that received a program smoke detector in 1990 or 1991.
bForty-three homes were unoccupied (18 MN, 16 NC, 9 OK); 17 addresses could not be located (0 MN, 9 NC, 8 OK); 5 mobile homes had been moved (1 MN, 3 NC, 1 OK); 3 homes had been converted to businesses (0 MN, 2 NC, 1 OK); 3 homes had been torn down (0 MN, 1 NC, 2 OK); and 1 household did not speak English (OK).
cNumber of completed interviews/(sampled addresses – ineligible addresses).

Table 2. Characteristics of households participating in the 1994 smoke detector evaluation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Minnesota (n = 117)</th>
<th>Cherokee County, North Carolina (n = 146)</th>
<th>Oklahoma City, Oklahoma (n = 173)</th>
<th>Total (n = 436)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replaced battery in past year</td>
<td>56 (59)</td>
<td>68 (52)</td>
<td>96 (72)</td>
<td>220 (61)</td>
</tr>
<tr>
<td>Household income ≥ $10,000 per year</td>
<td>65 (56)</td>
<td>55 (38)</td>
<td>77 (45)</td>
<td>197 (45)</td>
</tr>
<tr>
<td>Used supplemental heat in 1993</td>
<td>41 (35)</td>
<td>77 (53)</td>
<td>36 (21)</td>
<td>154 (35)</td>
</tr>
<tr>
<td>At least 1 adult &gt; 64 years old</td>
<td>19 (16)</td>
<td>92 (63)</td>
<td>63 (36)</td>
<td>174 (40)</td>
</tr>
<tr>
<td>Own home</td>
<td>60 (51)</td>
<td>128 (88)</td>
<td>112 (65)</td>
<td>300 (69)</td>
</tr>
<tr>
<td>Lived there during detector distribution</td>
<td>80 (68)</td>
<td>131 (90)</td>
<td>120 (69)</td>
<td>331 (76)</td>
</tr>
<tr>
<td>Aware of detector distribution</td>
<td>71 (89)</td>
<td>127 (97)</td>
<td>116 (97)</td>
<td>314 (95)</td>
</tr>
<tr>
<td>At least 1 tobacco smoker</td>
<td>72 (62)</td>
<td>50 (34)</td>
<td>77 (45)</td>
<td>199 (46)</td>
</tr>
<tr>
<td>At least 1 high school graduate</td>
<td>93 (79)</td>
<td>77 (53)</td>
<td>116 (67)</td>
<td>286 (66)</td>
</tr>
<tr>
<td>At least 1 child &lt; 5 years old</td>
<td>60 (51)</td>
<td>13 (9)</td>
<td>32 (18)</td>
<td>105 (24)</td>
</tr>
</tbody>
</table>

aBattery replacement applies only to battery-operated detectors.
bTwelve percent declined to report or did not know income.
cPercentage of respondents living in home during the intervention who were aware of the distribution.
sota and North Carolina program households and 78% of Oklahoma households had at least one detector. Thus, the programs helped to increase the prevalence of detectors in households that reported having no working detectors to near or above the national rate of 88%. However, maintaining the battery-operated detectors remains a challenge. The proportion of evaluation households in Minnesota and Oklahoma with at least one working detector was below the national rate of 70% (62% in Minnesota, 58% in Oklahoma). Overall, homes that were occupied by the same people during both the distribution and evaluation were no more likely to have a working detector than homes that were occupied by different people. This finding suggests that the detector maintenance instructions given to participants when the detectors were distributed did not have an enduring effect.

The Oklahoma program had the lowest proportion of households with working detectors despite its more extensive follow-up. This finding is due mostly to the lower proportion of Oklahoma households with a detector, working or not. Given the presence of any type of detector, functionality was similar across programs (75% in Oklahoma, 77% in North Carolina, and 66% in Minnesota). Differences in how participants were recruited and detectors were distributed may partially explain why Oklahoma households were least likely to have a detector. The Oklahoma program canvassed door-to-door in a defined geographic area, giving a detector to any household that reported needing one. Less than 10% of the distributed detectors were installed by program staff. In contrast, North Carolina participants either called the fire department or picked up a detector at a distribution site, and 67% of all

### Table 3. Status of smoke detectors in households participating in the 1994 smoke detector evaluation

<table>
<thead>
<tr>
<th></th>
<th>Minnesota</th>
<th>Cherokee County, North Carolina</th>
<th>Oklahoma City, Oklahoma</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>At least 1 smoke detector</td>
<td>110 (94)</td>
<td>139 (95)</td>
<td>135 (78)</td>
<td>384 (88)</td>
</tr>
<tr>
<td>(95% confidence interval for %)</td>
<td>(90–98)</td>
<td>(91–99)</td>
<td>(72–84)</td>
<td></td>
</tr>
<tr>
<td>At least 1 working smoke detector</td>
<td>72 (62)</td>
<td>107 (73)</td>
<td>101 (58)</td>
<td>280 (64)</td>
</tr>
<tr>
<td>(95% confidence interval for %)</td>
<td>(53–71)</td>
<td>(67–79)</td>
<td>(52–66)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of smoke detector</th>
<th>n</th>
<th>(95% confidence interval for %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery-operated</td>
<td>95 (86)</td>
<td>130 (94)</td>
</tr>
<tr>
<td>AC, hard-wired</td>
<td>11 (10)</td>
<td>7 (5)</td>
</tr>
<tr>
<td>AC, plug-in</td>
<td>1 (&lt;1)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Combo AC and battery</td>
<td>3 (3)</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Missing battery</td>
<td>22 (58)</td>
<td>13 (41)</td>
</tr>
<tr>
<td>Dead battery</td>
<td>6 (16)</td>
<td>18 (56)</td>
</tr>
<tr>
<td>Battery disconnected</td>
<td>7 (18)</td>
<td>8 (25)</td>
</tr>
<tr>
<td>AC disconnected</td>
<td>5 (13)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Cover missing or broken</td>
<td>5 (13)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Chamber clogged or dirty</td>
<td>5 (13)</td>
<td>2 (6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition of nonworking detectors</th>
<th>n = 38</th>
<th>n = 32</th>
<th>n = 34</th>
<th>n = 104</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing battery</td>
<td>22 (58)</td>
<td>13 (41)</td>
<td>25 (74)</td>
<td>60 (58)</td>
</tr>
<tr>
<td>Dead battery</td>
<td>6 (16)</td>
<td>18 (56)</td>
<td>5 (15)</td>
<td>29 (28)</td>
</tr>
<tr>
<td>Battery disconnected</td>
<td>7 (18)</td>
<td>8 (25)</td>
<td>4 (12)</td>
<td>19 (18)</td>
</tr>
<tr>
<td>AC disconnected</td>
<td>5 (13)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Cover missing or broken</td>
<td>5 (13)</td>
<td>3 (9)</td>
<td>7 (21)</td>
<td>15 (14)</td>
</tr>
<tr>
<td>Chamber clogged or dirty</td>
<td>5 (13)</td>
<td>2 (6)</td>
<td>1 (3)</td>
<td>8 (8)</td>
</tr>
</tbody>
</table>

a Some nonworking smoke detectors had more than one problem.

### Table 4. Associations between household characteristics and having at least one working detector in the 1994 smoke detector evaluation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Minnesota [RR (95% CI)]</th>
<th>Cherokee County, North Carolina [RR (95% CI)]</th>
<th>Oklahoma City, Oklahoma [RR (95% CI)]</th>
<th>Total [RR_MH (95% CI)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replaced battery in past year c</td>
<td>1.9 (1.2, 3.1)</td>
<td>3.1 (1.5, 6.5)</td>
<td>2.0 (1.3, 3.0)</td>
<td>2.1 (1.6, 2.8)</td>
</tr>
<tr>
<td>Household income ≥ $10,000 per year d</td>
<td>1.8 (1.2, 2.9)</td>
<td>1.6 (0.9, 2.8)</td>
<td>1.3 (0.8, 2.0)</td>
<td>1.5 (1.2, 2.0)</td>
</tr>
<tr>
<td>Used supplemental heat in winter 1993</td>
<td>1.4 (0.7, 2.6)</td>
<td>1.4 (0.9, 2.1)</td>
<td>0.9 (0.4, 2.0)</td>
<td>1.3 (0.9, 1.8)</td>
</tr>
<tr>
<td>At least 1 adult &gt; 64 years old</td>
<td>1.7 (0.6, 4.9)</td>
<td>1.0 (0.8, 1.4)</td>
<td>1.4 (0.8, 2.4)</td>
<td>1.2 (0.9, 1.5)</td>
</tr>
<tr>
<td>Own home</td>
<td>1.5 (0.9, 2.3)</td>
<td>1.1 (0.9, 1.3)</td>
<td>1.2 (0.9, 1.6)</td>
<td>1.2 (1.0, 1.3)</td>
</tr>
<tr>
<td>Lived there during detector distribution</td>
<td>1.4 (1.0, 2.0)</td>
<td>1.0 (0.9, 1.1)</td>
<td>1.2 (0.9, 1.4)</td>
<td>1.0 (1.0, 1.1)</td>
</tr>
<tr>
<td>At least 1 tobacco smoker</td>
<td>0.8 (0.6, 1.1)</td>
<td>0.9 (0.5, 1.6)</td>
<td>0.8 (0.5, 1.3)</td>
<td>0.8 (0.6, 1.0)</td>
</tr>
<tr>
<td>At least 1 high school graduate</td>
<td>1.1 (0.9, 1.4)</td>
<td>2.2 (1.2, 4.1)</td>
<td>1.0 (0.8, 1.3)</td>
<td>—</td>
</tr>
<tr>
<td>At least 1 child &lt; 5 years old</td>
<td>1.2 (0.8, 1.8)</td>
<td>0.7 (0.2, 2.6)</td>
<td>0.4 (0.2, 1.2)</td>
<td>—</td>
</tr>
</tbody>
</table>

a: unadjusted risk ratio.
b: Mantel-Haenszel summary risk ratio where Breslow-Day test for homogeneity P value ≥ 0.20.
c: Battery replacement applies only to battery-operated detectors.
d: Twelve percent of respondents did not report or did not know income.
distributed detectors were installed. In Minnesota, participants agreed to have their homes inspected for injury hazards, and all of the detectors were installed by program staff.

Overall, in 76% of households with nonworking detectors, the battery was either missing or disconnected. Nuisance alarms were cited as a common reason for removing the detector battery. The 1992 Smoke Detector Operability Survey reported similar findings and suggested that the low-battery signal or “chirp” may be misinterpreted as a malfunction in the detector. Whatever the cause, the problem of disconnecting detector batteries could be minimized if detectors were properly located and batteries were replaced annually. Some new detectors have silence buttons that, when pressed, temporarily stop nuisance alarms. Improvements in detectors’ smoke sensors could further reduce the likelihood of nuisance alarms.

Because battery-operated smoke detectors are inexpensive and easy to install, they are commonly used in detector distributions. These detectors require fresh batteries about every year. The long-term effectiveness of programs distributing battery-operated detectors will thus depend largely on regular battery replacement. Detector promotion programs should consider distributing detectors that do not need replacement batteries or find effective ways to ensure that batteries are replaced yearly. The two types of detectors that do not require replacement batteries, electrically-powered detectors, and 10-year lithium battery-powered detectors, are considerably more expensive than conventional battery-powered detectors. Further study is needed of the relative costs and benefits of installing low-maintenance detectors versus maintaining conventional detectors in high-risk households.

During 1990 and 1991, when the programs were installing detectors, the National Fire Protection Association (NFPA) recommended that existing dwellings have a properly located, working detector near each separate sleeping area and on each additional floor of living space. None of these three programs adopted the NFPA guideline. Not surprisingly, many of the evaluation households had fewer than the recommended number of detectors. Future programs should provide each household with the number of detectors needed to meet the NFPA recommended standard.

The evaluation has several limitations. Because the programs were not intervention trials, control groups were not used. Although the North Carolina and Oklahoma programs used more than one method to distribute detectors, the evaluation did not assess differences in effectiveness of the various distribution methods. In North Carolina and Oklahoma, “need” for a smoke detector was determined by asking a household member if the home had a working detector. Because these homes were not inspected before detectors were distributed, we cannot know how many of them were protected only by program detectors. Lastly, because the programs targeted different high-risk groups and used different distribution and follow-up methods, direct comparison of the evaluation results across programs may not be informative or practical.

A separate evaluation of the Oklahoma smoke detector program’s effectiveness in reducing residential fire injuries was conducted in 1994. It reported an annualized residential fire injury rate in the target area during the 32-month period before the detector distribution of 15.3 per 100,000 population. In the 4 years after the distribution, the area’s annualized fire injury rate was 3.1 per 100,000 population, reflecting an 80% decline. Although the decline in the fire injury rate cannot be directly attributed to the detector program, the finding suggests that programs such as the ones described here can reduce residential fire injuries.

The Healthy People 2000 objectives call for at least one working smoke detector on each habitable floor of all dwellings. Efficient, targeted approaches for increasing smoke detector ownership and maintenance among high-risk populations will be needed to meet this objective. This evaluation suggests that visiting homes can be an effective method for distributing and evaluating the status of smoke detectors in high-risk households. If conventional battery-operated detectors continue to be distributed to high-risk households, more effective methods are needed for maintaining them.

The evaluation was designed, home visits were conducted, and the questionnaire data were electronically coded under a contract with Battelle’s Centers for Public Health Research and Evaluation. The authors acknowledge Michael T. Halpern, MD, PhD, MPH, Peter McMenamin, PhD, Ruth Brown, MS, MSPA, and Leticia Howland, all formerly of Battelle, for their contributions. The authors also thank Pauline Harvey, MSPH, of NCIPC for assisting with data management, and Dana Loomis, PhD, and Carol Runyan, PhD, of the University of North Carolina for providing comments on an earlier draft.

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