Improving Firearm Storage in Alaska Native Villages: A Randomized Trial of Household Gun Cabinets

David C. Grossman, MD, MPH, Helen A. Stafford, EdM, Thomas D. Koepsell, MD, MPH, Ryan Hill, MPH, Kyla D. Retzer, MPH, and Ward Jones, MA

Objectives. We determined if the installation of gun cabinets improved household firearm storage practices.

Methods. We used a wait list, randomized trial design with 2 groups. The "early" group received the intervention at baseline, and the "late" group received it at 12 months. Up to 2 gun cabinets were installed in each enrolled home, along with safety messages. In-person surveys were conducted at 12 and 18 months to determine the proportion of households reporting unlocked guns or ammunition. Direct observations of unlocked guns were also compared.

Results. At baseline, 93% of homes reported having at least 1 unlocked gun in the home, and 89% reported unlocked ammunition. At 12 months, 35% of homes in the early group reported unlocked guns compared with 89% in the late group ($P < .001$). Thirty-six percent of the early homes reported unlocked ammunition compared with 84% of late homes ($P < .001$). The prevalence of these storage practices was maintained at 18 months. Observations of unlocked guns decreased significantly (from 20% to 8%) between groups ($P < .03$).

Conclusions. Gun cabinet installation in rural Alaskan households improved the storage of guns and ammunition. If these gains are sustained over time, it may lead to a reduction in gun-related injuries and deaths in this population. (*Am J Public Health.* 2012;102:S291–S297. doi:10.2105/AJPH.2011.300421)

Rates of suicide in Alaska are far higher than in the remainder of the United States and are even higher among Alaskan Native youths living in rural parts of Alaska.[1] Between 2000 and 2006, the rate of firearm-related suicide among Alaskan Native males aged 15 to 19 years was more than 4 times higher than that among Alaskan White males in the same age group and more than 10 times higher than that among US White male teens.[2]

Existing evidence associates household firearm ownership with an increased risk of suicide, both among adults and adolescents.[3–9] As in many rural parts of the United States, firearm ownership in Alaska is highly prevalent and related to the frequent use of guns for subsistence hunting.[10] Storing household guns locked or unloaded has been associated with a reduced risk of child and adolescent firearm injuries that were related to suicidal behavior or unintentional injuries.[4,5,8,11,12] Furthermore, ample evidence exists that many children in the United States live in homes with accessible firearms.[13–15] Community-based programs that improve the safe storage of household guns represent one strategy to mitigate the injury risks associated with high rates of access to household firearms by youth.[16–18]

An earlier pilot project by some members of this team tested the initial feasibility and acceptability of a community-based intervention to install gun cabinets in Alaskan Native households in a southwestern Alaskan village. The proportion of homes with any self-reported unlocked guns in the participating households decreased from 85% at baseline to 14% 3 months after cabinet installations.[19]

To test the durability and generalizability of these findings among other rural Alaskan households, we conducted a randomized controlled trial with households in 6 villages. The aim of this trial was to determine if the installation of gun cabinets in rural Alaskan homes would lead to an improvement, compared with control homes without cabinets, in household firearm storage practices at 12 and 18 months after installation.

METHODS

This was an unblinded, community-based randomized controlled trial to determine if the invitation to receive a gun cabinet to securely store household firearms would be associated with an improvement in specific self-reported firearm storage practices in the home. The trial used a wait list design, in which all households eventually received the intervention, and households were randomized to one of 2 groups.

Members of the "early intervention group" (referred to here as the "early" group) received their gun cabinets at baseline, after initial storage practices were measured. The "late intervention group" (also referred to as "late" group) received their gun cabinets 12 months after baseline. Follow-up was conducted again at about 18 months to track changes in gun storage practices in the late group and to gather additional longer term follow-up data with the early group. The primary analysis compared storage practices between the 2 groups at 12 months from baseline, and focused on the outcomes of locked guns and ammunition.

All study procedures were reviewed and approved by the institutional review boards of the University of Washington and the Alaska Area Indian Health Service. The study was also approved by the Bristol Bay Area Health Corporation (BBAHC) and the Yukon Kuskokwim Health Corporation (YKHC).

The site for this study was the Bristol Bay and Yukon-Kuskokwim Delta regions of western Alaska. There are a total of 85 unincorporated villages within the 2 regions, all of which are inhabited largely by residents of Alaskan Native descent. Six villages in the 2 regions were requested to participate and agreed to partake in this study. The 6 villages were selected because of their match of population size to sample size requirements, and their accessibility to air transportation. The size of these villages ranged from 24 to 165

households. All of the villages were accessible by air and water transport; none were accessible by road. Individual village tribal councils approved village participation and suggested procedures for enrolling village residents in the trial.

Participants

The unit of randomization was the household, defined as an occupied dwelling within the village. Households were included in the study if they met all of the following criteria: (1) there was at least 1 adult respondent older than 21 years present at the time of enrollment period, (2) the respondent was one of the principal owners or renters of the dwelling, (3) the respondent reported at least 1 gun usually present in the household, and (4) the household did not already possess an operational gun safe to store long guns.

The University of Washington investigators worked with collaborators from the statewide Alaska Native Tribal Health Consortium (ANTHC), the 2 regional Native health corporations, BBAHC and YKHC, and village tribal governments to identify and validate all currently occupied dwellings in each village using a map. Where no map was available, the village was initially surveyed, and all dwellings were mapped by study staff. A census of inhabited dwellings was developed with village officials, in which each occupied household was assigned a unique identification number.

Fieldwork and data collection were conducted by small groups composed of ANTHC staff, regional health corporation staff, and University of Washington investigators working together with a local village resident who served as a liaison and translator. Villagers were notified of the study through the posting of notices in key village locations (e.g., stores and the post office, by VHF radio) and were offered the opportunity to opt out of having contact with the study team.

Assisted by the village liaison, the field staff approached each numbered household identified on the map to determine eligibility for participation in the study. If no occupant was present, the survey staff returned at least 2 additional times during the survey period, which usually lasted 1 to 2 days. Households that refused participation (n = 25) were not contacted again. Signed consent for enrollment was sought once eligibility was established, and a baseline survey was administered by staff. Survey staff members were not aware of the household's group assignment at baseline.

Randomization and Allocation Concealment

After completion of baseline surveys, the complete roster of enrolled households was faxed back to the ANTHC office for group assignment. A study investigator at ANTHC then retrieved a computer-generated random assignment list from a locked file for the requisite number of households. Single-block randomization was used to construct the assignment lists, so that in a village with n eligible households, $n/2$ were chosen at random for assignment to the early group, and the remaining $n/2$ went to the late group. The original household roster, to which treatment-group assignments had then been added, was faxed back to study field staff in the village.

Intervention

The intervention for the early group occurred 1 to 3 weeks after the conclusion of the baseline survey and again at 12 months for the late group. The intervention included the installation of a free metal gun cabinet, along with instructions and handout on use, and a brief safety message about keeping all guns and ammunition locked in the cabinet. The homeowners were also instructed to keep the key in a secure location.

Participants were informed that the cabinet had to be installed by staff to prevent injury and relocation of the cabinet. The installer observed and certified that all guns and ammunition were secured in the cabinet after demonstrating its use.

The gun cabinet (Model GC 908-5; Stack-On Corporation, Wauconda, IL) is steel, has a 3-point locking system with a keyed lock, and holds up to 8 long guns of up to 54 inches in length. An upper shelf can be used to store handguns and ammunition. The retail price of the cabinet was about $80 at the time of purchase.

Data Collection

Survey data were collected at baseline, and at 12 and 18 months after baseline. The instrument was administered by staff to an adult member of the household who was identified as "having the greatest knowledge about guns in the home." The 13 items in the structured survey focused on household gun and ammunition storage practices. Each survey took about 10 minutes to complete. Interviewers also observed whether any guns or ammunition were visible outside a safe or cabinet around the interior of the home, including the "arctic" entry porch. Follow-up surveys were conducted in the same manner. The survey instrument used in follow-up was very similar in content and length to the one used at baseline.

No direct contact was made with the households after the baseline period until approximately 12 months later, when the village was visited again by study staff. Village administrators were aware of the follow-up visit, but enrollees were not directly informed in advance.

Analysis

All analyses followed the intent-to-treat principle. Groups or families were analyzed with regard to their original group assignment, even if they had changed dwellings within the village. The primary outcomes were whether any guns were unlocked, whether any guns were unlocked and loaded, and whether both a gun and ammunition were unlocked at the 12-month survey. Statistical tests of the null hypothesis of no intervention effect were based on comparing these proportions between early and late groups using the χ^2 or Fisher's exact test, if the expected frequency in any cell was less than 5. Two-sample t-tests were used for other continuous outcomes. A planned subgroup analysis compared households with and without children aged 18 years or younger.

In later analyses that used data from all 3 time points, we tested the null hypothesis of parallel time trends in outcomes between the early and late groups. For each outcome, the statistical significance of group-by-time interactions was assessed in a logistic regression model that accounted for correlated observations in a household using generalized estimating equations. Analyses were done with the R statistical language version 2.10.1 (R Foundation for Statistical Computing, Vienna, Austria).

The study power estimates were based on the projected recruitment of a final sample of 300 households with complete follow-up data.

We estimated at least 80% power to detect an absolute difference of 13% between the intervention and control groups for unlocked guns and 90% power to detect absolute differences of 16%.

RESULTS

A total of 385 households in the 6 villages were approached for participation in the study (Figure 1). Of these, 25 (6.5%) declined to be interviewed; 47 (12.2%) of the households were vacant, and an adult head of household could not be contacted. Of the 313 households screened for eligibility, 259 (82.7%) were eligible for participation, and 255 (98.5%) agreed to enroll. The single main reason for lack of eligibility was the lack of a gun in the home. At the 12-month follow-up, we were able to recontact 214 (84%) of households recruited at baseline (81% of the early group compared with 87% of the late group). At the 18-month follow-up, we interviewed 206 households, or 81% of those recruited at baseline.

The study groups were comparable at baseline (Tables 1 and 2). Households in the late group appeared to be somewhat more likely to own a handgun (23% early vs 31% late) at baseline, and this difference persisted at follow-up. Very few households in either group (4% early and 1% late) reported owning a gun safe or locking cabinet at baseline. A high proportion (25% in both groups) reported owning either 1 or more cable or trigger locks, but only 27% to 35% reported that any of them were in use at the time of the survey. A very high proportion of early and late households reported having at least 1 gun and/or ammunition unlocked at baseline. Children were reported to be living in households in 73% of the early group and in 71% of the late group.

At the 12-month follow-up, 94% (96 of 102) of the households in the early group reported owning a gun cabinet compared with only 6% of the late homes. Some crossover occurred as some enrollees in the early group moved cabinets between households. However, we did not detect any significant shift of firearms from homes in 1 group to the other.

We detected important differences at the 12-month follow-up visit between groups with regard to firearm storage practices. Only 35% (35 of 101) of homes in the early group reported having any guns unlocked at the time of the survey compared with 89% (93 of 105) in the late group ($P<.001$). At the 18-month follow-up, only 35% of homes in both groups reported having any gun unlocked.

A similar effect was detected with ammunition. The proportion of the early group reporting any ammunition unlocked at 12 months was 36% compared with 84% in the late group ($P<.001$). The proportion of homes reporting both a gun and ammunition unlocked, arguably the highest risk scenario, also differed markedly between groups in the early and late groups (23% vs 78%; $P<.001$). These reductions were also sustained out to 18 months in the early group.

Some practices did not appear to change. Homes reporting at least 1 gun that was loaded did not show a statistically significant difference between groups at 12 months. There was also little difference between the groups with regard to their reports of ownership and use of trigger locks or cable locks.

At baseline, unlocked guns were observed by the study team in 20% of the early intervention homes, compared with 8% of the late intervention homes ($P=.023$). At 12- and 18-month follow-up, guns were observed in only 8% and 11% of the homes, respectively, in the early group compared with 14% and 13%, respectively, in the late group. These trends were statistically significantly different in the generalized estimating equations analysis ($P=.03$).

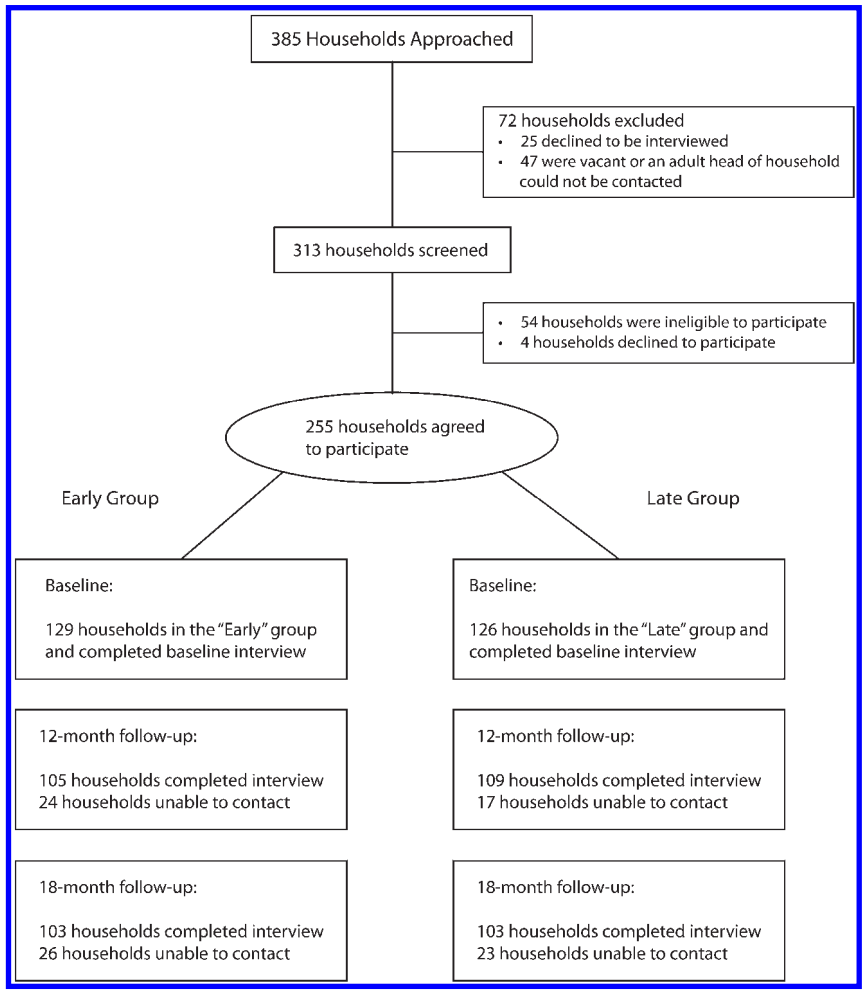

FIGURE 1—CONSORT FLOW DIAGRAM with sample disposition and follow-up: improving firearm Storage in Alaska Native Villages, 2005–2007.

TABLE 1—Household and Respondent Characteristics for Randomized Households With Interview Data: Improving Firearm Storage in Alaska Native Villages, 2005–2007

	Baseline		12 Months		18 Months	
	Early (n = 129)[a]	Late (n = 126)[a]	Early (n = 105)[a]	Late (n = 109)[a]	Early (n = 103)[a]	Late (n = 103)[a]
Completed interview, no. (%)	129 (100)	126 (100)	105 (81)	109 (87)	103 (80)	103 (82)
Village, no. (%)						
A	11 (9)	10 (8)	8 (8)	10 (9)	7 (7)	8 (8)
B	9 (7)	9 (7)	9 (9)	7 (6)	8 (8)	7 (7)
C	23 (18)	24 (19)	15 (14)	22 (20)	15 (15)	20 (19)
D	10 (8)	10 (8)	5 (5)	7 (6)	6 (6)	6 (6)
E	28 (22)	27 (21)	25 (24)	25 (23)	25 (24)	26 (25)
F	48 (37)	46 (37)	43 (41)	38 (35)	42 (41)	36 (35)
People in household, mean ±SD	4.5 ±2.6	4.5 ±2.5	4.8 ±2.8	4.6 ±2.4	4.6 ±2.8	4.4 ±2.6
Children in household, no. (%)						
None	35 (27)	36 (29)	23 (22)	30 (28)	29 (29)	32 (31)
1	21 (16)	20 (16)	24 (23)	22 (20)	17 (17)	19 (18)
2	25 (20)	18 (14)	14 (13)	16 (15)	12 (12)	14 (14)
3	18 (14)	19 (15)	18 (17)	13 (12)	19 (19)	13 (13)
4	12 (9)	9 (7)	10 (10)	10 (9)	5 (5)	8 (8)
≥5	17 (13)	24 (19)	16 (15)	18 (17)	19 (19)	17 (17)
Respondent age, y, no. (%)						
19–29	14 (11)	21 (17)	17 (16)	19 (17)	10 (10)	14 (14)
30–39	29 (22)	28 (22)	18 (17)	23 (21)	17 (17)	21 (20)
40–49	35 (27)	34 (27)	34 (32)	31 (28)	31 (30)	25 (24)
50–59	26 (20)	26 (21)	20 (19)	20 (18)	19 (19)	27 (26)
≥60	25 (19)	17 (13)	16 (15)	16 (15)	25 (25)	16 (16)
Respondent gender, no. (%)						
Female	33 (26)	37 (29)	26 (25)	31 (28)	24 (23)	32 (31)
Male	96 (74)	89 (71)	78 (75)	78 (72)	79 (77)	70 (69)
Interpreter used, no. (%)						
Yes	6 (5)	2 (2)	4 (4)	3 (3)	4 (4)	2 (2)
No	114 (95)	119 (98)	100 (96)	106 (97)	98 (96)	99 (98)
Respondents with guns in home, no. (%)						
Yes	128 (99)	125 (99)	103 (98)	105 (96)	98 (96)	98 (95)
No	1 (1)	1 (1)	2 (2)	4 (4)	4 (4)	5 (5)
Guns (if any), no. (mean ±SD)	123 (6.6 ±4.3)	120 (6.8 ±5.4)	97 (7.4 ±5.2)	102 (7.5 ±6.3)	95 (7.1 ±4.1)	93 (7.4 ±5.4)
Respondents with rifles, no. (%)						
Yes	122 (96)	117 (95)	98 (97)	99 (94)	96 (100)	89 (95)
No	5 (4)	6 (5)	3 (3)	6 (6)	0 (0)	5 (5)
Rifles (if any), no. (mean ±SD)	122 (3.9 ±2.5)	117 (4.0 ±3.3)	98 (4.2 ±2.8)	99 (4.4 ±3.8)	96 (3.9 ±2.2)	89 (4.3 ±3.2)
Respondents with shotguns, no. (%)						
Yes	118 (94)	115 (92)	100 (98)	95 (91)	93 (97)	91 (94)
No	8 (6)	10 (8)	2 (2)	9 (9)	3 (3)	6 (6)
Shotguns (if any), no. (mean ±SD)	118 (2.7 ±1.6)	115 (2.5 ±1.6)	100 (2.8 ±1.9)	95 (3.0 ±2.4)	93 (2.8 ±1.7)	91 (2.7 ±1.7)
Respondents with handguns? No. (%)						
Yes	29 (23)	38 (31)	28 (29)	33 (32)	25 (26)	32 (34)
No	95 (77)	83 (69)	69 (71)	70 (68)	70 (74)	62 (66)
Handguns (if any), no. (mean ±SD)	29 (1.7 ±1.1)	38 (2.1 ±1.7)	28 (2.1 ±1.9)	33 (2.1 ±1.7)	25 (1.9 ±1.7)	32 (2.2 ±1.7)

[a]Households with missing data excluded

TABLE 2—Gun Storage at Baseline, 12 Months, and 18 Months: Improving Firearm Storage in Alaska Native Villages, 2005–2007

	No. Yes/Total No. (%)[a]		
	Early Group	Late Group	*P*[b]
Own gun safe or cabinet?			< .001
Baseline	5/126 (4)	1/121 (1)	.2
12 mo	96/102 (94)	6/105 (6)	< .001
18 mo	95/98 (97)	92/97 (95)	.5
Own trigger/cable lock?			.2
Baseline	33/126 (26)	31/123 (25)	> .999
12 mo	26/103 (25)	33/104 (32)	.4
18 mo	22/95 (23)	28/95 (29)	.4
Trigger/cable lock now in use?			.5
Baseline	9/33 (27)	11/31 (35)	.7
12 mo	7/25 (28)	11/33 (33)	.9
18 mo	6/23 (26)	5/27 (19)	.8
Any guns loaded?			.8
Baseline	12/128 (9)	15/122 (12)	.6
12 mo	5/99 (5)	10/104 (10)	.3
18 mo	6/93 (6)	9/97 (9)	.7
Any guns unlocked?			< .001
Baseline	121/127 (95)	112/124 (90)	.2
12 mo	35/101 (35)	93/105 (89)	< .001
18 mo	32/98 (33)	36/94 (38)	.5
Any guns loaded and unlocked?			.3
Baseline	11/127 (9)	14/122 (11)	.6
12 mo	2/102 (2)	9/103 (9)	.065
18 mo	3/95 (3)	4/97 (4)	> .999
Any ammunition unlocked?			< .001
Baseline	109/122 (89)	108/122 (89)	> .999
12 mo	37/102 (36)	86/102 (84)	< .001
18 mo	29/103 (28)	29/100 (29)	> .999
Both a gun and ammunition unlocked?			< .001
Baseline	106/121 (88)	104/121 (86)	.08
12 mo	23/101 (23)	80/102 (78)	< .001
18 mo	18/98 (18)	15/95 (16)	.8
Observed guns not locked up?			.03
Baseline	22/112 (20)	9/110 (8)	.023
12 mo	8/102 (8)	15/109 (14)	.2
18 mo	11/99 (11)	12/95 (13)	.9
Observed ammunition not locked up?			-
Baseline	8/111 (7)	0/110 (0)	.007
12 mo	2/102 (2)	2/109 (2)	> .999
18 mo	3/99 (1)	1/95 (1)	.6

Note. Dash indicates that no comparison could be made because there were zero households in the late group in which ammo was observed not locked up.
[a]Households with missing data excluded.
[b]For test of early/late difference at each time point, and for test of parallel time trends with generalized estimating equations for overall categories.

A subanalysis was performed to determine if the findings differed among households with children (data not shown). The effect of the intervention appeared not to be modified by the presence of 1 or more children in the home. The trend of observations of unlocked guns was not statistically significant in this subsample.

No adverse health events associated with the intervention were reported or noted.

DISCUSSION

We found that the installation of gun cabinets in homes of Alaskan Native village residents led to substantial improvements in gun and ammunition storage practices, particularly in the locking of guns and ammunition. The intervention led to the reduction of an important risk factor for firearm injury among youth in and around these homes.

Loaded guns were also more likely to be locked up in households with a gun cabinet. The intervention, with its emphasis on gun safety, also did not appear to affect the use of other firearm safety devices also present in these homes, such as cable locks and trigger locks. The low rate of use of these devices at baseline might reflect some concerns regarding these devices expressed anecdotally by residents, including the need to maintain track of multiple keys and difficulty with handling and use.

The intervention effects were very similar among households with and without children. This might reflect the local culture and environment, where children are welcome as unannounced visitors in almost all homes, especially because virtually all residents have extended family with children residing in the village. Accordingly, heads of households with and without children might be equally motivated to improve gun storage practices. Other studies reported storage practices did not appear to be significantly influenced by the presence of children.[13,20]

We also did not note changes in the prevalence or distribution of household guns in the village after the early group received their gun cabinets. There was no evidence that the installation of gun cabinets led to increased gun acquisition in those households and increased household firearm density.

Although other research explored the use of physician counseling or community campaigns

as a means to promote safe storage practices, we were unaware of other trials that attempted to promote gun safety through the installation of gun storage devices in the home.[16,18,21–23]

We believe that the success of this intervention was a result of a strong community–academic partnership, in which local and regional tribal organizations performed careful foundational work to determine the stage of community readiness, the acceptability of the intervention and evaluation procedures, as well as careful planning to maximize feasibility of dissemination of the intervention after the conclusion of the trial.[24]

Study Limitations

One limitation of this study was that the generalizability of these findings might be restricted to specific settings and populations. Alaskan Native villages are culturally unique, given their isolation, homogeneity, and strong social adhesion and unification. Village governments have been successful in promoting other unique public health initiatives, such as alcohol restriction policies.[25] The residents of these villages are also acutely aware of the magnitude of the suicide risk in this geographic region, and might have been sensitive to the intervention without the need for motivational enhancement or messaging beyond the simple messages of the value of gun and ammunition locking.

Another limitation was that a gun cabinet designed for rifles and shotguns might not be suitable for urban communities, where households more commonly reported exclusive handgun ownership. Finally, it was unclear whether gun-owning households in non-Native communities would routinely welcome the installation of these gun cabinets in their households. However, the direct installation of smoke detectors in homes by fire departments and public health authorities has been recognized as a similarly successful intervention in many United States and international communities.[26,27]

Several findings served to support the validity of the findings in the absence of blinding. First, we noted that other firearm safety practices, such as loading guns or use of trigger locks, did not change measurably, as one might expect if social desirability bias existed. Second, study staff were unaware of the study group assignment of households as they entered a home, when many of the observations of guns were made. They were only aware of the presence of a gun cabinet if they observed it, or if the respondent reported receiving one. Reporting bias associated with respondent gender was reported for both gun storage practices in homes with children.[28] The high and stable proportion of male respondents in both groups across time minimized the impact of this type of bias.

Conclusions

We concluded that the installation of gun cabinets in homes in rural Alaskan Native villages was a highly feasible and acceptable community-based intervention that sharply reduced the proportion of homes reporting unlocked guns and ammunition over an 18-month period. If these gains are sustained over time, it may lead to a reduction in gun-related injuries and deaths in this population. ■

About the Authors

David C. Grossman is with Group Health Research Institute, Seattle, WA. Helen Andon Stafford is with the Alaska Native Tribal Health Consortium, Anchorage. Thomas D. Koepsell is with the Departments of Epidemiology and Health Services, University of Washington, Seattle. At the time of the study, Ryan Hill was with the Alaska Native Tribal Health Consortium. Kyla D. Retzer was with the Yukon Kuskokwim Native Health Corporation, Bethel, AK. Ward Jones is with the Bristol Bay Area Health Corporation, Dillingham, AK.

Correspondence should be sent to David Grossman, MD, MPH, Group Health Research Institute, 1730 Minor Ave, Suite 1600, Seattle, WA 98101 (e-mail: grossman.d@ghc.org). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

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Contributors

D. C. Grossman conceptualized, designed, and supervised the study; he also obtained funding, participated in data collection, assisted with the analyses, and led the writing. H. A. Stafford helped to supervise the study, obtained funding, participated in data collection, assisted with interpretation findings, and reviewed drafts of the article. T. D. Koepsell participated in the design of the study and data collection, led the analyses, and contributed to the writing of the article. K. D. Retzer assisted with the design of the study, data collection, and interpretation, and reviewed drafts of the article. R. Hill assisted with the design of the study, assisted with study supervision, data collection and interpretation, and review of article drafts. W. Jones assisted with the design of the study, assisted with data collection, and reviewed article drafts.

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Human Participant Protection

All study procedures were reviewed and approved by the institutional review boards of the University of Washington and the Alaska Area Indian Health Service. The study was also approved by the Bristol Bay Area Health Corporation and the Yukon Kuskokwim Health Corporation.

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