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A randomized controlled trial of public messaging to promote safe firearm storage among U.S. military veterans

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Abstract

Background: The objectives of this study were to determine whether short-term exposure to firearm safety messaging significantly improved (1) firearm storage practices, and (2) attitudes of safe firearm storage behaviors among U.S. veterans, a group at elevated risk for firearm suicide.

Design: A three-arm, parallel-group RCT was conducted online in the U.S. nationwide from December 2015 to January 2016.

Setting: A national random sample of U.S. veterans ($N = 358$) was recruited from the GfK KnowledgePanel, a probability-based internet panel representative of U.S. adults. All study activities were administered online over a three-week study period.

Intervention: Participants were randomized and exposed three times (once per week) to either (a) firearm safety message only ($n = 115$); (b) firearm safety and mental health promotion messages ($n = 133$); or (c) active control group exposed to mental health promotion message only ($n = 110$). Each message was less than two minutes long.

Measures: Assessments were completed at baseline (pre-randomization) and at end-of-trial. Changes in awareness of risk for injuries, attitudes/beliefs related to safe storage practices, behavioral intentions, and storage practices were measured using self-reported surveys. Linear mixed effect models with weighted generalized estimating equations were used to test for exposure effects. Analyses were conducted February 2018.

Results: Analyses restricted to those with baseline firearm access ($n = 195$) identified no significant changes for intentions or safe storage practices across exposure groups. At baseline,

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participants' attitudes and beliefs were generally supportive of safe firearm storage. The Firearm Safety message yielded small increases in agreement with the concept that secure storage is "important during emotional or stressful times" (0.36; 95% *CI* = 0.08, 0.64). Other significant changes in awareness and beliefs were found, but across all study conditions.

Conclusion: Results reinforce the critical need for considerable research and testing prior to the widespread implementation of public messages to increase the likelihood for desired exposure effects.

Keywords

Firearm suicide; U.S. veterans; Safe firearm storage; Health education; Public health campaign; Health promotion

1. Introduction

Veterans have elevated suicide rates compared with their civilian peers, and suicides among veterans are more likely to result from a firearm injury (U.S. Department of Veterans Affairs, 2016). While approximately half of all suicides involve the use of a firearm among the U.S. general population, this mechanism accounts for nearly 70% of all veteran suicides (U.S. Department of Veterans Affairs, 2016). Strategies to reduce access to highly lethal means show promise for reducing rates of suicide (U.S. National Action Alliance for Suicide Prevention, 2014; U.S. Office of the Surgeon General, 2012; Mann et al., 2005; Vandroos et al., 2019). Safe storage practices (e.g., locked and unloaded when not in use) are approaches that may decrease suicide risk by limiting access during times of distress through voluntary behaviors implemented at home (Grossman et al., 2005; Kellermann et al., 1992). Observational evidence supports interventions facilitating safe storage that have been implemented across contexts (both upstream from and proximal to suicidal crisis) and populations (Rowhani-Rahbar et al., 2016; McGee et al., 2003). Such efforts recognize storage behaviors as a function of individual and social factors and seek to influence the underlying mechanisms driving behavior change (Rowhani-Rahbar et al., 2016; McGee et al., 2003). While nearly half of all veterans own at least one firearm, recent data indicate that safe storage practices are not widespread among this group (Cleveland et al., 2017; Ilgen et al., 2008). Further exploration of methods to increase the likelihood that veterans will accept and adopt recommended practices is needed.

Public messaging offers a viable mechanism to promote safe firearm storage practices by targeting factors that underpin behaviors to motivate change. Broadly informed by models of health behavior (Ajzen and Gilbert Cote, 2008; Fishbein and Cappella, 2006; Hornik and Yanovitzky, 2003; Ajzen, 1985), this type of intervention is theorized to drive desired shifts in firearm storage practices by influencing antecedents (e.g., knowledge; attitudes) that increase the likelihood for behavior change and support the development of larger social environments (e.g., social beliefs) that validate and motivate targeted behaviors. To date, several studies of public messaging have applied behavior change frameworks and demonstrated their ability to modify both cognitive and behavioral outcomes consistent with theorized processes for a range of public health issues including suicide prevention (Pirkis et al., 2017; Wakefield et al., 2010; Snyder et al., 2004) with evidence to support their use with

veterans (Karras et al. 2016, 2017; Bossarte et al., 2014; Langford et al., 2013). Yet, only a small corpus of research, with few controlled trials testing effects, has been published on messaging to address firearm safety (Mann and Michel, 2016). Specifically, little is known about the effects of exposure to public messages on firearm storage beliefs and behaviors among veterans. The larger communication literature suggests some promise for messaging to encourage safe storage practices, particularly when coupled with efforts to translate messages to action (i.e., distribution of gun safety devices) (Wakefield et al., 2010; Noar, 2006; Coyne-Beasley et al., 2001). Despite such potential, this research also points to the challenges of effective message design and use to promote firearm safety (i.e., appropriate persuasive appeals; culturally tailored content) (Marino et al 2016, 2017; Mueller, 2018), underscoring the need for further investigation of this type of messaging with members of high risk populations.

The current study reports findings from a randomized trial testing exposure effects of the firearm safety messaging developed by the U.S. Department of Veterans Affairs (VA) with a national random sample of veterans. This public service announcement (PSA) was conceptualized as an upstream suicide prevention effort intended to educate veterans on the significance of safely storing firearms when not in use. To date, no evaluative efforts have been published on this message. Therefore, the primary objective of the study was to determine if changes in safe storage intentions and household practices were associated with message exposure among participants with access to firearms. While no specific model was tested, the current study considered how existing theories predict health behavior. Such approaches broadly argue that behavior change is a process (Ajzen and Gilbert Cote, 2008) influenced by several theoretical factors such as attitudes and beliefs. Messaging seeks to move a population “towards a behavior” where changes may first occur among determinants that underlie targeted behaviors (Fishbein and Cappella, 2006). From a prevention perspective, due in part to the possibility of dynamic access to firearms and the importance of community-based awareness of risk, we take these benchmarks to be critical components of suicide prevention programs promoting safe storage of, and access to, firearms. Integrated together, the secondary objective of the study was to test the hypothesis that attitudes and beliefs related to safe storage practices significantly improved following short-term exposure to the firearm safety message. The VA planned to disseminate the firearm safety message in tandem with other mental health communications; yet, how exposure to multiple types of messages influences outcomes related to firearm safety is unknown. Thus, this study also sought to examine the effects on attitudes and behavior related to safe storage when both mental health promotion and firearm safety messages were used.

2. Method

2.1. Overview

This study used a three-arm, parallel-group randomized controlled trial design in which participants were randomly assigned with equal probability to one of two intervention conditions with exposure to the (a) firearm safety message only (condition one); (b) both mental health promotion and firearm safety messages (condition two); or the (c) active control group exposed to a mental health promotion message only (condition three). A

national, random sample of veterans was recruited for the trial in December 2015 from the GfK KnowledgePanel, a probability-based internet panel representative of adults in the United States. Participants were sent messages three times (once per week) and assessed twice (baseline; exit) over a three-week period during December 2015 to January 2016. All study activities were administered online by GfK (and within the GfK website) to veterans belonging to the KnowledgePanel. Participants were blinded to study arm allocation. A waiver of consent was obtained for this study, which was approved by the VA IRB in Syracuse, NY.

2.2. Sample

GfK KnowledgePanel consists of approximately 55,000 U.S. adults that are randomly selected with household sampling methods (KnowledgePanel design summary) using addresses obtained from the Delivery Sequence File maintained by the U.S. Postal Service. This database includes 97% of all U.S. residential households; individuals are recruited by GfK through a series of contact attempts by mail and telephone. GfK provides free internet service and hardware (e.g., tablet) for adults recruited from households without internet connection. Provision of internet service and hardware improves population coverage and helps compensate for differences in landline telephone use and internet access. Following panel enrollment, participants complete a short demographic survey available to researchers that improves future panel sampling and weighting. Base weights are applied to the panel by GfK using geodemographics from the U.S. Current Population Survey (CPS) as benchmarks. Study-specific post-stratification weights are constructed to adjust for the study's sample design and patterns of nonresponse. GfK's population-based probability sampling approach has been previously described (Journals publishing KnowledgePanel data). Evaluation of outcome estimates calculated using data from GfK have demonstrated comparable prevalence for a range of health-related measures when comparing the KnowledgePanel to national surveys using other methodologies to recruit and collect data (e.g., by telephone or in-person) (Yeager et al., 2011; Chang and Krosnick, 2009; Heeren et al., 2008; Bethell et al., 2004).

For the current study, veterans 18 years and older living in the U.S. (non-institutionalized) belonging to the GfK KnowledgePanel that could speak/read English were eligible to participate. Those with and without firearm access were included in the study to examine larger social beliefs among veterans and allow for comparisons. GfK's profile data determined veteran status among participants. Individuals were recruited by invitational email with one reminder notification to non-responders. Inequality tests for a repeated measures design were conducted to determine a sample of 70 per group (210 total) was sufficient to detect a statistically significant change in outcomes.

Of the 854 panel members sent the baseline survey, 344 declined to participate and 36 exclusions were made for participants that could not see/hear a test video; 474 veterans completed the baseline assessment and were then randomized to one of three study conditions; and 116 participants did not complete study activities (i.e., view videos) and were not eligible to receive the exit survey. This process yielded a final sample of $N = 358$ included in analyses (see Fig. 1).

2.3. Procedures

Enrolled participants received a notification email from GfK that indicated a study activity was available for completion. The email contained a custom link directly to the study activity (i.e., watch PSA; complete survey) that was available on participants' personalized pages within the GfK website. Each active KnowledgePanel member has a personalized homepage that lists assigned studies and pending activities. Participants self-reported that they could see/hear a test video prior to viewing study PSAs; once played, videos could not be manipulated (i.e., stopped/fast-forwarded) and were timestamped (start/end) to ascertain viewing. One email reminder was sent to non-responders three days after the initial notification. This process was repeated for each time point in the study.

Surveys were collected at baseline and end of trial that assessed awareness, attitudes/beliefs, and behaviors (if applicable) related to safe firearm storage and risk for injury. Participants were randomized following completion of the baseline survey and then immediately exposed to a message based on assigned condition. Two subsequent messages were sent to participants at one- and two-weeks post-randomization with an exit survey administered immediately following the third message exposure. Individuals randomly assigned to condition one were sent the Firearm Safety PSA to view once per week (three times total). Condition two received the "Veterans' Voices" PSA (mental health message) at time point one followed by the firearm safety message for the remaining two time points to examine the potential effects of mixed exposures. Condition three served as an active control group that received the "Veterans' Voices" PSA across all exposure time points. To receive the exit survey, individuals were required to have (a) completed the baseline assessment and (b) viewed messages for at least two (of the three) exposure time points. All measures, excluding demographics (collected only at baseline), were repeated across time points (baseline/exit) for all conditions and consisted of self-reported Likert-style items (detailed below). The survey took on average 20 min to complete.

2.4. PSAs

Two public messages developed by VA were used in this study: (a) Firearm Safety PSA. This PSA was developed in 2014 and targets antecedents such as awareness of factors that increase/decrease risk for suicide and firearm injury as well as knowledge of methods for safe storage to improve the likelihood for behavior change. Consistent with best practices for message design (Noar, 2006), content was tailored towards veterans and their families and informed by consideration of military culture. Households with and without firearm access were intentionally targeted to promote safe firearm storage as normative behavior among the broader veteran community.

(b) The "Veterans' Voices" PSA from the VA's Make the Connection campaign was utilized as the mental health PSA in the current study. The Make the Connection campaign is ongoing and provides veterans and their families with information on a range of mental health issues (e.g., sleep disorders; depression) and treatment. It also connects them to available resources to seek help and provide support to cope with life events (e.g., divorce; job loss). The message featured snapshots of interviews with real veterans (representing a range of diverse audience segments) sharing their experiences with mental health concerns

(e.g., recognizing symptoms; overcoming challenges; seeking help). At the close of the PSA, viewers are encouraged to connect with other veterans on the campaign website (“I’m a veteran, I know what it’s like ... there’s a whole community of veterans out there who just want to help”). “Veterans’ Voices” was selected as the mental health PSA for this study based on availability, content (i.e., mental health promotion), and comparable design features (i.e., < 2 min long; quality; production) and target audience (i.e., veteran populations) to the Firearm Safety PSA.

2.5. Survey measures

Participants were asked to report access to household firearms (yes/no) as well as limited demographics. Current storage practices (e.g., locked/unloaded) and intentions to secure household firearms in the next month were collected as primary outcomes among those with firearm access using a five-point Likert scale similar to that described below. Participants were also asked to answer a series of survey items to capture secondary outcomes: (a) to what extent they felt members of their own (self-defined) community were at risk for suicide and firearm injury (“awareness”) (b) how effective safe storage practices (i.e., unloaded; unlocked); were to reduce risk for serious injury or death (“efficacy beliefs”); (c) agreement with statements of “normative beliefs” for safe firearm storage in the home (e.g., most veterans safely store firearms in their homes); and finally, (d) agreement with “attitudes towards safe storage practices for suicide prevention” (e.g., safe firearm storage can decrease suicide risk). Responses to all questions were captured on five-point Likert scales ranging from low (one) to high (five) endorsement of each item. Safe storage was explicitly defined as firearms stored unloaded and locked using a safety device (e.g., gun safety lock; gun safe) when not in use with ammunition kept separately (National Shooting Sports Foundation).

2.6. Data analysis

Study data were weighted by GfK to be representative of the U.S. veteran population by age and gender using the August 2014 Current Population Survey (U.S. Census Bureau, 2014). Analyses were restricted to participants that completed both baseline and exit surveys. Descriptive statistics were tabulated by frequencies and weighted percentages or mean and standard deviation, as appropriate. We first sought to describe the baseline distributions of responses to the survey measures listed above to characterize several determinants and behaviors related to reported firearm safety among veterans. Next, linear mixed effect models with weighted generalized estimating equations (GEE) were used to test hypotheses concerning exposure effects on each primary outcome across conditions among participants with firearm access. GEE is a semiparametric approach that is robust to violations of several assumptions associated with use of standard parametric approaches and was selected for its ability to model non-normal, correlated data collected in repeated measure studies (Cui and Qian, 2007; Hardin & Hilbe 2002; Lipsitz et al., 1994). Sub-analyses were performed to examine attitudinal changes associated with message exposure among all participants (secondary outcomes). Interactions were considered a priori to examine relationships between time and condition assignment on model outcomes. Logistic regression was performed to determine if any demographic characteristics predicted group assignment; all models controlled for education and firearm access reported at baseline. Imputation of missing data was not applied as less than five percent of data were missing for any measure

included in this study (see Tables 1 and 2). All analyses were performed using SAS 9.4 (Cary, NC) with two-sided tests and p -value < 0.05.

3. Results

3.1. Sample characteristics

Table 1 summarizes the baseline characteristics of the sample with bivariate analyses (chi-square tests) examining differences by firearm access (yes/no). The majority of participants were white (80.78%), middle-aged or older (45+) (82.90%), married (76.89%), and male (90.00%). Individuals primarily resided in metro areas (81.53%) in the Southern U.S. (40.35%) and reported some college education (35.75%). Considerable proportions self-reported fair or poor physical (25.36%) and mental health (14.05%) status in the past 30 days. Approximately 20% had utilized health services from the Veterans Health Administration (VHA) in the past year. Half of the sample (50.80%) reported access to household firearms. Demographic variables were not significantly associated with firearm access. The composition of the study sample was comparable to the larger veteran population, which is predominately older, white, and male and more likely to be married when compared to the U.S. general population (U.S. veteran population estimates; Profile of veterans 2016).

3.2. Descriptive analyses of outcomes at baseline

3.2.1. Current practices and intentions for safe storage—Of the 195 participants with firearm access, only 15.29% reported safely stored household firearms at baseline (see Table 2). Approximately half (50.91%) of those with firearm access were likely or extremely likely to store safely in the next month. Conversely, 26.88% indicated they were unlikely or extremely unlikely to store their household firearm safely in the next month. Finally, 22.21% indicated they were neither unlikely nor likely to subsequently engage in safe firearm practices.

3.2.2. Awareness of community risk—Results in Table 2 suggest many participants viewed firearm injury (50.96%) and suicide (53.70%) as low risks to community members. Nearly one third of the sample believed these injuries to be moderate risks, while 10.73% and 4.22% felt firearm injury and suicide posed a high risk, respectively. Less than three percent of participants believed their communities were at extremely high risk for either injury. Conversely, nearly 12% perceived no risk for suicide among community members (vs. 4.74% for firearm injury).

3.2.3. Efficacy beliefs related to safe storage—Survey items assessed safety measures separately (firearms stored locked; firearms stored unloaded) to identify any nuances in beliefs (see Table 2). Participants believed locking household firearms (72.33%) as well as storing firearms unloaded (55.83%) were effective or very effective injury prevention measures. Greater proportions believed storing firearms unloaded (31.62%) was somewhat effective at reducing risk for injury or death vs. storing them locked (18.85%). A smaller number of participants (< 15%) reported both strategies as ineffective for injury prevention.

3.2.4. Normative beliefs of firearm safety—Table 2 reveals nearly 40% agreed/strongly agreed that safe storage was a common practice among veteran households, while less than 10% disagreed/strongly disagreed. Considerable proportions of participants agreed safe firearm storage was an important community concern (despite low awareness of risk for injury to its members) but believed the onus was with the firearm owner to enact storage practices. When asked about risk among the broader population, 49.27% agreed/strongly agreed firearms were involved in a large number of injuries or deaths in the U.S. (vs. 27.59% that neither agreed/disagreed vs. 23.14% that disagreed/strongly disagreed). Approximately half of participants did not hold strong beliefs (i.e., neither agreed/disagreed) towards the significance of safe storage to their community or that veterans secured their household firearms.

3.2.5. Attitudes towards safe storage practices for suicide prevention—Participants generally agreed with attitudinal measures listed in Table 2 in support of safe storage as a strategy for suicide prevention. For example, nearly half of participants believed safe storage could decrease suicide risk, and even larger proportions agreed these practices were especially important when risk factors were present (i.e., periods of emotional/stressful times; substance use). Further, 69.22% agreed/strongly agreed suicidal individuals should store firearms outside of the home. While five percent disagreed/strongly disagreed with this statement, 26.33% held no strong attitude towards offsite storage for those with increased suicide risk. Nearly half of participants (48.68%) disagreed/strongly disagreed doctors should ask about firearm access during patient encounters (vs. 18.42% who agreed/strongly agreed they should discuss firearms); 32.89% neither agreed/disagreed that these types of conversation should occur.

3.3. Regression analyses

First, analyses were restricted to those with baseline firearm access ($n = 195$) to identify significant associations between exposure and changes in the intentions to perform safe storage in the next month as well as actual behaviors (primary objective). The adjusted models identified no significant findings for either outcome across exposure groups (not shown). Next, the study's secondary objectives were examined using all participants (i.e., those with and without firearm access). Table 3 summarizes significant GEE results from the adjusted models with the active control condition (condition three) serving as the reference category for analyses. Descriptive statistics (weighted M; SD) for each outcome were also provided by condition. Model 1 revealed that only one attitude towards safe storage for suicide prevention was significantly associated with message exposure. Those who were sent the Firearm Safety PSA (condition one) reported lower agreement with “safe firearm storage during emotional or stressful times is important” at baseline. A significant increase in the endorsement of this attitude was found post-exposure among this group (0.36; 95% $CI = 0.08, 0.64$). This finding lends partial support for our hypothesis pointing to the potential for firearm safety messaging to promote the significance of secure storage during periods of increased risk. Conversely, Model 2 presents a decrease in agreement (-0.13 ; 95% $CI = -0.26, -0.004$) with the normative belief, “safe firearm storage is the responsibility of the firearm owner,” across all three conditions over time. Finally, results for Model 3 show a significant increase in awareness of community risk for suicide across conditions over time

(0.36; 95% *CI* = 0.06, 0.67). While results indicate improved awareness of community vulnerability to suicide, intervention conditions did not uniquely generate significant changes when compared to the active control.

4. Discussion

The primary objective of this study was to identify associations between firearm safety messaging and changes in safe storage intentions and behaviors. Both outcomes were not improved among participants with firearm access during this brief trial. Results are consistent with several campaign studies from elsewhere in public health that have found limited behavioral effects associated with short-term message exposure. Yet communication research also suggests some potential promise for messages to encourage behavior change with longer-term repeated use (Noar et al., 2010; Terry-McElrath et al., 2013; Huhman et al., 2010). Such trends in messaging effects are also evident for behaviors resistant to change that may parallel firearm storage such as substance use (Harrington et al., 2003; Palmgreen et al., 1991; Ramanadhan et al., 2017). Thus, continued research of the potential for messaging to produce safe storage is warranted to assess behavior change over extended exposure periods.

The VA Firearm Safety PSA distinctly improved one attitude related to suicide prevention during the study period (not evident in the other study conditions) (see Table 3). Consistent with the message's upstream approach, participants expressed greater agreement that secure storage was important during emotional or stressful times following exposure to the Firearm Safety PSA (condition one). Such short-term changes have various implications. Findings are meaningful from a communications perspective by informing what attitudes are (and are not) amenable to change with message use. They also offer support for how communication is theorized to influence behaviors by providing some evidence of attitudinal change related to perceived firearm risk among targeted audiences shortly after exposure. While this finding may be attributed to the study design or sample, repeated message use is often needed to achieve targeted changes (Noar, 2006; Snyder et al., 2004), underscoring the significance of our short-term result with veterans.

The Firearm Safety PSA was no more likely to influence other study outcomes than messaging to promote mental health (i.e., the Veterans' Voices PSA). The dearth of research on firearm safety messaging limits comparisons to other published studies, although results offer initial insights on barriers to message use (RAND Corporation, 2018). For example, an increased awareness of community risk for suicide was evident over the study period but not associated with exposure to any specific message (see Table 3). Such findings parallel the larger persuasion literature that argues for extensive pre-testing of messages to generate desired effects, and points to knowledge-based outcomes as more amenable to short-term change than attitudes or behaviors (Noar, 2006; Snyder et al., 2004). This preliminary trend warrants further research but may offer campaign designers initial insights for streamlining dissemination of related messaging efforts targeting veterans. Participants also reported a decreased belief that safe storage was the responsibility of the firearm owner (see Table 3). While there may be multiple interpretations for such results (e.g., increased belief of community role in risk reduction; adverse response), it is of particular consequence if

messaging contributes to a reduced likelihood for firearm owners to take action towards safe storage (either now or in the future). Future studies should consider explicit measures of such unintended effects with evidence-based typologies used in other campaign research (Cho and Salmon, 2007).

Significant shifts were also not found for many attitudes and beliefs measured in this study. Descriptive statistics in Table 2 offer a more nuanced look and show large proportions of veterans endorsed these items at baseline. While these trends may provide insights as to why short-term changes in outcomes were not evident, it also suggests that veterans' attitudes are generally supportive of the safe household storage of firearms prior to exposure to messaging. Subsequent research could explore how to best use messages to increase the accessibility of these beliefs to facilitate changes in targeted behaviors. Such findings also help to elucidate future targets for messaging to influence secure household storage. For example, when considering future research directions from a theoretical lens, communicative interventions for veterans who endorse firearm safety could shift focus from attitudinal outcomes to strengthening factors such as intentions that immediately precede behavior. Finally, a number of participants also reported neutral responses to attitudinal measures. There is prior research to suggest it may be easier for persuasion to shape new attitudes rather than counter (negative) existing ones (Ivanov et al., 2016), underlining a potentially distinct segment to target with future messaging to effectively shift outcomes.

4.1. Limitations and future research

Several limitations should be noted. First, this study represents initial steps to understand how public messages can be used to promote firearm safety to veterans. Continued evaluation efforts are needed to determine the efficacy of this message to change related attitudes and behaviors among this group. While the use of a controlled trial to assess relationships was a strength, proximal effects of exposure on study outcomes were only evaluated. Additional research is needed to assess long-term effects associated with message exposure, what factors (e.g., gender, age, media use, suicide risk) influence changes, and how they may translate into behaviors. Future studies may also consider indirect pathways for messages to facilitate safe storage practices (e.g., via social networks). Limited external validity is also noted underscoring the need for future studies to assess message use in real world contexts. The VA sponsored the PSAs tested in this study, which may have influenced veterans' responses to persuasive attempts surrounding firearms, a deeper social and cultural topic. Veteran perspectives were not obtained during the development of study messaging (not conducted by the research team). A theoretical framework was not used to guide message design nor was it tested during the evaluation. The effects of this decision are not fully measured here; yet messages informed by established theories and insights obtained from audience members have been found to elicit greater response. These messages are more likely to understand behavioral change processes and match the characteristics, preferences, and needs of targeted groups. Such findings further underscore the critical need for both theory and direct veteran involvement in future messaging efforts and assessment of their effects. Message dissemination was controlled within the GfK website, effectively limiting opportunities to manipulate PSA viewing (e.g., there was no fast-forwarding), although participant attention to study PSAs was primarily ascertained with pressing play

and time stamps. Additional manipulation checks should be included to confirm message views in future research. The reliability and validity of measured outcomes in this study were also not assessed. All measures were self-reported from participants belonging to a probability-based research panel. While GfK KnowledgePanel implements efforts to reduce associated biases, data are still subject to response and recall bias. While data were weighted to be representative of adult U.S. veterans, findings are not generalizable to the broader population. Future research should aim to be more inclusive and involve under-represented veteran groups such as females, and racial and ethnic minorities.

5. Conclusions

Findings reinforce the critical need for considerable research on public messaging prior to widespread implementation to increase the likelihood for desired effects. Yet few studies have appraised firearm storage messages or (related) suicide prevention messages prior to dissemination, effectively limiting the number of research-driven communication strategies available. Continued research is needed to further assess the effects of exposure to this type of messaging over time with heterogeneous samples to inform targeted future use with this population.

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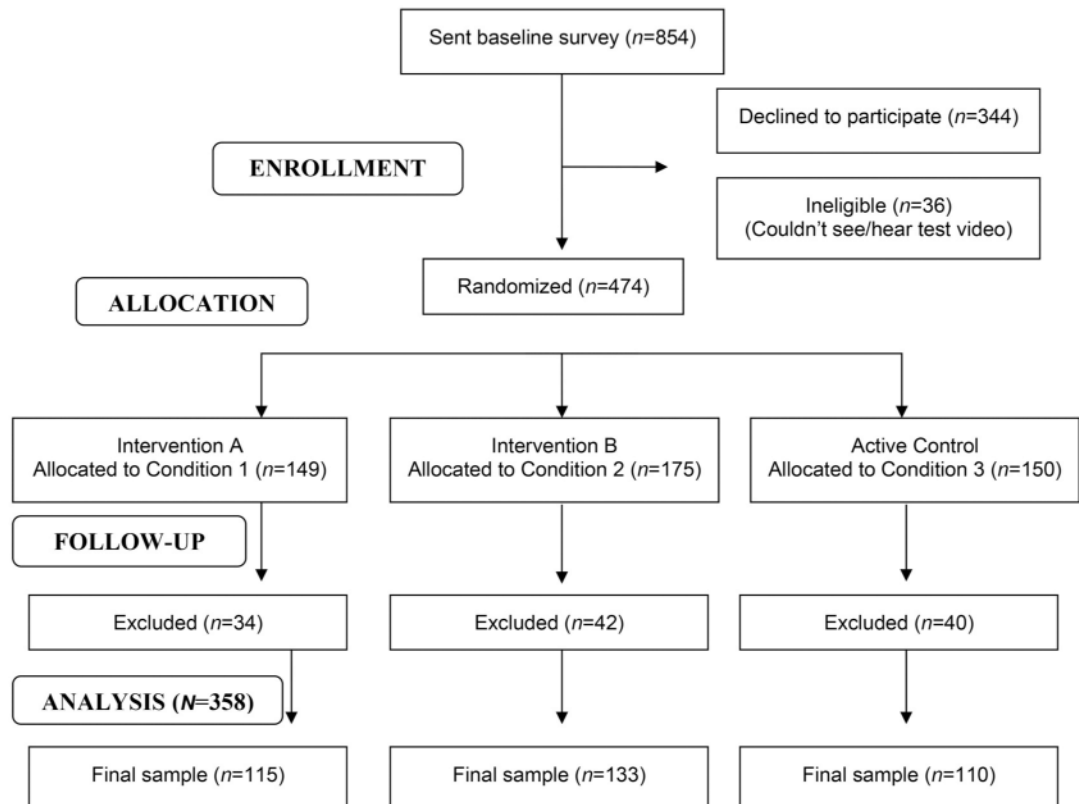


Fig. 1.
Flow of participants through the trial.

Table 1Study sample characteristics,^a U.S. December 2015–January 2016(*N* = 358).

Variable	weighted % (<i>n</i>)	Firearm access <i>p</i> -value
Age		0.57
18–29	4.08 (5)	
30–44	13.02 (21)	
45–59	26.58 (88)	
60+	56.32 (244)	
Missing	.00 (0)	
Sex (male)	90.00 (337)	0.57
Missing	.00 (0)	
Race/Ethnicity		0.25
White, Non-Hispanic	80.78 (301)	
Black, Non-Hispanic	10.29 (27)	
Other, Non-Hispanic	3.42 (11)	
Hispanic	5.50 (19)	
Missing	.00 (0)	
Combat exposure (yes)	19.44 (80)	0.46
Missing	0.70 (3)	
Health status in past 30 days ...		
Subjective Physical health		0.35
Good/excellent	74.64 (270)	
Fair/poor	25.36 (88)	
Missing	.00 (0)	
Subjective Mental health		0.73
Good/excellent	85.95 (319)	
Fair/poor	14.05 (39)	
Missing	.00 (0)	
VHA use in past 12 months (yes)	20.75 (77)	0.47
Missing	.00 (0)	
Household size		0.45
1	17.04 (65)	
2	53.27 (209)	
3+	30.69 (84)	
Missing	.00 (0)	
Education		0.36
High school or less	35.14 (120)	
Some college	35.75 (122)	
Bachelor's degree or higher	29.11 (116)	
Missing	.00 (0)	
Marital status (married)	76.89 (273)	0.06
Missing	.00 (0)	

Variable	weighted % (n)	Firearm access p-value
Region		0.67
Northeast	14.80 (48)	
Midwest	22.75 (79)	
South	40.35 (153)	
West	22.10 (78)	
Missing	.00 (0)	
Metro resident (yes)	81.53 (288)	0.15
Missing	.00 (0)	
Firearm access (yes)	50.80 (195)	–
Missing	0.99 (4)	
Among those with firearm access, firearm stored locked and unloaded at baseline	15.29 (53)	

^a survey data collected from a national random sample of veterans of U.S. military service from the GfK KnowledgePanel.

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Table 2
 Baseline distributions of attitudes related to safe firearm storage,^a U.S. December 2015–January 2016 (N = 358).

Variable	1 weighted % (n)	2 weighted % (n)	3 weighted % (n)	4 weighted % (n)	5 weighted % (n)	Missing Weighted % (n)
	No risk	Low risk	Moderate risk	High risk	Extremely high risk	
Awareness [injury] is a risk to members of your community						
Firearm injury	4.74 (16)	50.96 (181)	30.75 (115)	10.73 (35)	2.82 (10)	.24 (1)
Suicide	11.53 (39)	53.70 (196)	29.75 (106)	4.22 (16)	.80 (1)	.00 (0)
Efficacy beliefs of injury prevention strategies	Not at all effective	Not effective	Somewhat effective	Effective	Very effective	
Firearms stored locked	5.28 (18)	3.54 (14)	18.85 (61)	35.47 (119)	36.86 (146)	.00 (0)
Firearms stored unloaded	7.90 (28)	4.64 (25)	31.62 (105)	37.64 (129)	18.19 (71)	.00 (0)
Normative beliefs of firearm safety	Strongly Disagree	Disagree	Neither disagree/agree	Agree	Strongly Agree	
Most veterans safely store firearms in their homes	1.58 (6)	7.69 (32)	51.74 (174)	27.50 (100)	11.48 (44)	.93 (2)
Safe storage is the responsibility of the firearm owner	2.78 (4)	.00 (0)	3.41 (10)	35.84 (130)	57.98 (214)	.00 (0)
My community believes safe firearm storage is important	1.75 (5)	3.06 (15)	49.68 (164)	32.83 (131)	12.68 (43)	.00 (0)
Firearms are involved in a large number of U.S. injuries & deaths	6.83 (23)	16.31 (61)	27.59 (93)	29.17 (113)	20.10 (67)	.18 (1)
Attitudes towards safe storage for suicide prevention	Strongly Disagree	Disagree	Neither disagree/agree	Agree	Strongly Agree	
Safe household firearm storage decreases suicide risk	9.24 (31)	16.76 (69)	26.41 (97)	32.74 (111)	14.84 (49)	.09 (1)
Safe household firearm storage is important to practice during emotional/stressful time	2.32 (8)	6.19 (16)	20.58 (70)	44.85 (161)	26.06 (103)	.00 (0)
Never mix substances w/firearms	.40 (1)	3.22 (6)	4.61 (19)	28.21 (90)	63.57 (241)	.83 (1)
Suicidal people should store firearms outside of home	2.59 (8)	1.87 (9)	26.33 (73)	35.04 (134)	34.18 (134)	.00 (0)
Doctors should ask patients about firearm access	27.46 (90)	21.22 (83)	32.89 (128)	12.06 (35)	6.36 (22)	.00 (0)
Intentions in the next month ...	Extremely unlikely	Unlikely	Neither unlikely/likely	Likely	Extremely likely	
For safe storage among those with firearm access (n = 195)	14.65 (26)	12.23 (27)	22.21 (31)	16.52 (33)	34.39 (66)	4.60 (12)

^aSurvey data collected from a national random sample of veterans of U.S. military service from the GfK KnowledgePanel.

Table 3

GEE estimates of significant changes associated with message exposure, ^a U.S. December 2015–January 2016.

Variable:	Model 1 ^f (n = 356) ^j Attitude: “Safe storage significant during emotional/ stressful times” ^g			Model 2 ^f (n = 357) ^j Normative Belief: “Safe storage responsibility of firearm owner” ^g			Model 3 ^f (n = 356) ^j Awareness: “Community risk for suicide” ^g					
	Weighted M (SD) Baseline Exit	Estimate	SE	95% CI	Weighted M (SD) Baseline Exit	Estimate	SE	95% CI	Weighted M (SD) Baseline Exit	Estimate	SE	95% CI
Condition 1 ^c	3.65 (1.08)	4.16 (.81)	-.58	-1.11, -.05	4.33 (.98)	4.37 (.60)	.35	-1.10, .27	2.34 (.71)	.46	.32	-16, 1.07
Condition 2 ^c	4.02 (.91)	4.18 (.82)	.09	-.38, .56	4.51 (.70)	4.84 (.63)	.18	-.49, .20	2.53 (.70)	.40	.30	-.19, .98
Condition 3 ^{c,d}	3.89 (.81)	4.01 (.92)	-	-	4.54 (.72)	4.41 (.77)	-	-	2.17 (.83)	2.53 (.70)	-	-
Time ^h	-	.12	.09	-.05, .29	-	-	.07	-.26, -.004	-	.36	.16	.06, .67
Time × condition 1	-	.36	.14	.08, .64	-	-	.19	-.18, .57	-	-.33	.20	-.72, .05
Time × condition 2	-	.04	.14	-.24, .32	-	-	.11	-.08, .29	-	-.20	.18	-.55, .15

^a Survey data collected from a national random sample of veterans of U.S. military service from the GfK KnowledgePanel.

^c Condition one = exposed to Firearm Safety PSA up to 3 times over study period; Condition two = exposed to Veterans' Voices PSA once and Firearm Safety PSA twice over study period; Condition three = Active control group exposed to Veterans' Voices PSA up to three times over study period.

^d Reference category is condition three (the active control group) for all analyses.

^e Responses to Likert scale item ranges from no risk (one) to extremely high risk (five).

^f Responses to Likert scale item ranges from strongly disagree (one) to strongly agree (five).

^g All models controlled for education and firearm access at baseline.

^h Time = three weeks over study periods from baseline to exit (end of trial).

ⁱ Bolded values indicate statistical significance at p < 0.05.

^j No imputation method was employed as less than one percent of data were missing for these analyses.