


Utilizing the Electronic Medical Record to Enhance Health Care Provider Delivery of Messages About the Safe Storage of Firearms

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Abstract

The goal of this project was to determine whether screening youth and parents for firearm presence and imbedding those results in the electronic medical record (EMR) increased health care provider (HCP) documentation of firearms and subsequent delivery of a safe storage message. The study took place in a large adolescent medicine practice. Fifty-six dyads (40% of eligible) were randomized to usual care or the intervention, in which screening results for firearms were imbedded in the EMR. Health care providers delivered a safe storage message to 20% of controls and 51.2% in the intervention ($P = .04$). When HCPs documented the delivery of a safe storage message, 64% of parents recalled hearing it, compared with only 36% when there was no documentation ($P = .012$). Therefore, we found that incorporating firearm screening into the EMR increases the attention HCPs give to delivering a firearm safe storage message and correlates with parents recalling having heard a safe storage message.

Keywords

Firearm Injury Prevention, Electronic Medical Record, Screening, Primary Care, Counseling

Background

Firearms continue to be the leading cause of morbidity and mortality among youth through age 18, accounting for the majority of violent death. From 2017 to 2019, 7625 youth died from firearms, with annual deaths during this period ruled to be homicide ranging between 1320 and 1481 and those from suicide deaths ranging from 887 to 1003.¹ Firearms have outpaced motor vehicles as the leading mechanism of death for 10- to 24-year-olds since 2015 with mortality rates per 100 000 of 15.0 and 12.8, respectively.¹ Firearms are involved in 89% of youth homicides and 47% of youth suicides.¹ Nonfatal firearm injuries among youth ages 13 to 24 years account for 35 000 injuries annually.¹ When firearms are used in a suicide attempt, there is a high fatality rate, with death occurring 90% of the time.²

In 2019, 4.4% of US high school students reported carrying a gun (not for hunting/sport) at least one day in the last year,³ and 4% of 12- to 18-year-olds reported having access to loaded handguns without adult permission.⁴ In Denver, where our study took place, community-based data revealed that 20% of adolescents indicated having access to a firearm, including 15% reporting having a friend with a gun.⁵

Finally, a significant number of youth have access to firearms. Azrael, based on a national sample of adults, showed that 34% of households with children below the age of 18 report firearm ownership, with only 30% of caregivers reporting that firearms are stored in the safest manner—unloaded and locked—and 20% reporting at least 1 gun stored in the least safe manner—loaded and unlocked.⁶

Role of HCPs

Health care providers (HCPs) can play a pivotal role by addressing parental safe storage of firearms in both

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outpatient pediatric⁷⁻⁹ and emergency care settings,¹⁰⁻¹² as they do in addressing other health risks. Distributing safe storage devices along with counseling has been shown to improve parental safe storage,⁷⁻⁹ reducing accessibility of guns by youth. Despite this, HCPs infrequently screen for or deliver counseling about firearm safety in the home.^{13,14} The American Academy of Pediatrics (AAP) periodic survey, last completed in 2019, indicated that only 20% of pediatricians “always” identified families with guns, though 57% say they “sometimes” identified families with guns.¹⁵ Importantly, pediatric trainees do not feel they are being taught to address gun safety, as 63% stated they never provide firearm-related counseling in any type of visit and do so only 15% of the time during well child visits.¹⁶

Evidence suggests that prescreening youth for a variety of health and behavioral concerns increases recognition of these issues by HCPs,^{17,18} though to our knowledge this has not been examined for firearms. In this article, we examine the extent to which utilizing the electronic medical record (EMR) to convey information from patient screening about firearm access to the HCP can influence the delivery of safe firearm storage messages by the HCP. We also examine the correlation between what HCPs’ documentation in the chart about delivering a safe storage message and the report by parents and youth about whether counseling about firearm safety occurred.

Methods

Patient Study Subjects

Youth, ages 12 to 18 years being seen for a routine physical examination or a mental health visit at the Children’s Hospital Colorado Adolescent Medicine Clinic with one of their parents, were eligible to participate in the initial screening. *Recruitment:* Research staff were notified electronically on a daily basis about patients who were scheduled for either an annual physical examination or a mental health issue. Research staff then contacted patients and their parents before their index appointment, by phone or via mail, inviting them to take the screen. This was conducted in Spanish if the EMR described the parent’s primary language as Spanish. Youth and parents were each screened separately using a 5-item “adolescent safety questionnaire” asking about seat belt use, having a driver’s license, whether they have sustained a concussion, use of helmets for biking/skateboarding/rollerblading, and whether there were any firearms in the home. The safety screen was used specifically to determine eligibility for this study and was not part of routine practice. If either the youth or

parent screened positive for the presence of firearms in the home, they were invited to participate in the study. An incentive of \$25 was offered for each phase of study participation. *Exclusion Criteria:* The following patients were excluded: (1) adolescents with cognitive disabilities, (2) adolescents residing in a group home or detention center, or (3) youth or parents could not communicate in either English or Spanish. *Assent/Consent:* If either the parent or the adolescent screened positive for firearms in the home, they were eligible to participate. Parents provided consent both for themselves and for their child to participate. Verbal consent was obtained by phone, and then written consent obtained when the patient presented for their appointment. Adolescents assented separately.

Study Process

In preparation for the study, the study principal investigator (E.J.S.) delivered 2 one-hour educational sessions to the clinicians and repeated this training as new residents rotated into the clinic, which occurred monthly. The first addressed the scope of firearm injury issues facing children and adolescents and included an electronic module on Counseling on Access to Lethal Means (CALM), developed by the Harvard Injury Control Center and the Colorado Department of Public Health and Environment.¹⁹ The second session reviewed approaches to counseling parents and youth on firearm safety, how the EMR was going to be used to convey the results of the screen, and which electronic tools, such as a Smart Set, were available for the HCPs to use in documenting the recognition of firearms in the home and the delivery of a safe storage message. A Smart Set is a tool in the EPIC EMR that facilitates an HCP to choose text that can be added to a note. The exact safety message that HCPs delivered was not scripted but left up to the discretion of the HCP in terms of how to counsel families on safer firearm storage.

Study Design

Youth and parent dyads were randomized using a random number generator to 1 of 3 study groups: (1) usual care group, (2) an intervention group that received counseling on firearm storage, and (3) an intervention group that received counseling on firearm storage plus being offered gun locking devices for safe storage in the home. For this article, groups 2 and 3 were combined to represent the intervention group, as the focus of this article is on screening and counseling delivered, which are the same for groups 2 and 3. The research assistant (RA) entered screening data obtained from the youth and

parent in the intervention group into the EMR. This included a range of questions about firearm presence and storage in the home, reported both by the adolescent and by the parent (see below for questions embedded in the EMR). A Best Practice Alert (BPA) was activated for intervention visits, in which a banner highlighted in yellow appeared, with the screening results available by clicking a link to the questionnaires within the BPA. We conducted a brief 1-week follow-up phone call to assess youth and parent recall of topics discussed at the visit, including whether firearms injury prevention was addressed, and lock boxes were offered and taken home.

Health care providers were not notified if patients were assigned to the usual care group. However, usual care in the clinic for annual physical examinations included a standard adolescent health history as part of a paper-and-pencil intake form, including a single question about whether there are any guns in the home.

Measures

Youth/Parent Firearm Access Screening Questions

Both parents and youth were asked these specific questions with response options of yes, no, or not sure, with the results subsequently embedded in the EMR before the visit took place, and therefore available for the HCP to view:

1. Are there any guns kept in or around your home or motor vehicle? Include those kept in a garage, or outdoor storage area.
2. What kind of guns are they? Are there any
 - a. Handguns (like a pistol or revolver)
 - b. Rifles or shotguns
 - c. Some other kind of guns

Those indicating that any type of gun was present in the home were also asked:

3. Are any of these guns usually stored loaded?
 - a. Yes, all of them
 - b. Yes, some of them
 - c. No, none of them
 - d. Not Sure
4. Are the guns usually locked up?
 - a. Yes, all of them
 - b. Yes, some of them
 - c. No, none of them
 - d. Not sure

To determine whether providers documented gun access risk and delivered safe storage counseling, the RA

conducted a chart review approximately 4 weeks after the appointment. The RA read through the entire medical note and recorded whether there was any documentation regarding any mention of firearms, including (1) access to firearms in the home, (2) whether counseling on safe storage was provided to the parent and/or adolescent, and (3) whether any type of gun locking device was distributed. The RA was not blinded to which group the subject was assigned, as the chart review revealed whether the screen was imbedded in the EMR.

Analysis

We used bivariate analysis and computed Pearson χ^2 and/or Fisher exact test (when cell sizes < 5) to compare the differences in HCP documentation of screening for firearm access when their patients were in the usual care versus the intervention group, and whether there were differences in youth/parent recall of receiving a safe storage message. We also examined the correlation between youth/parents recall of hearing a safe storage message and HCP chart documentation of the delivery of a safe storage message. Initial analysis showed that there were no demographic differences between groups 2 and 3 (see Table 1). In addition, few parents ($n = 4$) elected to take home any safe storage devices. As both groups 2 and 3 received counseling on safer storage, these groups were combined to be defined as the *intervention* group.

Results

Study Enrollment

In total, we screened 1475 youth-parent dyads for firearm access over a 3-year period; 139 (9.4%) reported the presence of firearms in or around the home and 76 of those (54.7%) agreed to participate. We excluded 10 participating youth as they represented sibling pairs, and 10 either withdrew or did not attend the index appointment, leaving 56 parent-youth dyads available for analysis. Of the 147 eligible providers, 120 (82%) agreed to participate. In total, we were able to review records from 41 intervention and 15 usual care visits. There were not statistically significant differences between the control and intervention groups, although the intervention group trended toward having more females (76% c/w 54%, $P = .12$) and had a higher proportion of youth who were white (48% c/w 21%, $P = .12$) See Table 1 for demographics.

Safe Storage Counseling Delivery by HCP

Significantly more (51.2%) HCPs documented safe storage counseling for patients in the intervention group

Table 1. Demographics of Youth Subjects.

Demographics	Usual care %	Means restriction only %	Means restriction + lock box %	Intervention group % ^a	χ^2 P value
Group	1 N = 15	2 N = 23	3 N = 19	2 + 3 N = 41	
Sex					
Male	46.2	26.1	21.1	23.8	.28
Female	53.8	73.9	78.9	76.2	
Race					
White	21.4	43.5	52.6	47.6	.20
Black	7.1	21.7	10.5	16.7	
Ethnicity					
Hispanic	71.4	30.4	31.6	31.0	
Age					
12-14	35.7	52.1	31.5	42.8	.29
15-18	64.3	47.8	68.5	57.3	
Insurance					
Public	56.2	47.6	36.9	42.9	.84
Private	43.8	52.2	63.2	57.1	
Appointment type					
Annual physical examination	73.7	65.4	66.7	69.8	.85
Mental health	10.5	11.5	19	13.2	
Other	15.8	23.1	14.3	17	

^aAs the 2 intervention groups are similar in regard to demographics, they were combined for the rest of the analysis as this study is focused on impact of screening on COUNSELING practices.

Table 2. Documentation and Youth/Parent Recall of Safe Storage Counseling.

	Control % (n) n = 15	Intervention group % (n) n = 41	χ^2 P value
Documentation by HCP of safe storage counseling provided			
Overall	20 (3/15)	51.2 (21/41)	.037
By appointment type			
Physical examination	25 (3/12)	71.4 (20/28)	.001
Mental health	0 (0/3)	16.7 (1/6)	.018
Youth report hearing safe storage message at baseline visit	40 (6/15)	63.1 (24/38)	.12
Parent report hearing safe storage message at baseline visit	26.7 (4/15)	47.4 (18/38)	.17
Parent or youth report hearing safe storage message at baseline visit	53.3 (8/15)	74.6 (29/39)	.07

Abbreviation: HCP, health care provider.

than for patients in the usual care group (20%) ($P = .037$) (Table 2). This was particularly true for youth presenting for an annual physical examination routine visit, as HCPs documented safe storage counseling for 71.4% of patients in the intervention group versus 25% of the usual care group ($P < .001$). For those patients presenting for a mental health appointment, the HCPs documented safe storage counseling for 16.7% of the patients

in the intervention group and none in the usual care group ($P = .018$).

Recollection of Safe Storage Counseling Being Delivered

Fifty-one of 56 youth and 53 of 56 parents could be reached for the 1-week follow-up survey (Table 2).

Table 3. Correlation Between Youth/Parent Subjects Recalling Hearing a Safe Storage Message From Their HCP and HCP Documentation of Delivering a Safe Storage Message.

	Overall	HCP documentation of delivery of safety message, n (%)	HCP no documentation of delivery of safety message, n (%)	χ^2 P value
Youth report hearing safe storage message				
Yes	30 (56.6)	15/30 (50)	15/30 (50)	.15
No	23 (43.4)	7/23 (30.4)	16/23 (69.7)	
Parent reports hearing safe storage message				
Yes	22 (41.5)	14/22 (63.6)	8/22 (36.4)	.012
No	31 (58.5)	9/31 (29)	22/31 (71)	
Parent or youth recalls hearing safe storage message				
Yes	37 (71.1)	18/37 (48.6)	19/37 (51.4)	.14
No	15 (28.8)	4/15 (26.7)	11/15 (73.3)	

Abbreviation: HCP, health care provider.

Sixty-three percent (25/39) of youth in the intervention group compared with 40% (6/15) ($P = .11$) in the control group reported hearing a safe storage message from their HCP. Similarly, 47.4% of parents (18/38) in the intervention group compared with 26.7% (4/15) of parents in the usual care group reported hearing a safe storage message from their HCP ($P = .17$). Combining youth and/or parent report, 74.6% in the intervention group reported hearing a safe storage message compared with 53.3% in the usual care group ($P = .07$).

Correlation Between Documentation of a Safe Storage Message and Youth/Parent Recall

We also compared HCP documentation of delivering a safe storage message and adolescent/parent recollection of hearing a safe storage message (Table 3). When HCPs documented the delivery of a safe storage message, 63.6% of parents recalled hearing that message, compared with 36.4% of parents recalling a safe storage message when there was no documentation of the delivery of that message ($P = .012$). Similarly, when HCPs did not document the delivery of a safe storage message, 71% of parents did not recall hearing a safe storage message ($P = .012$). However, for adolescents, that correlation did not occur, as 50% of adolescents reported hearing a safe storage message regardless of whether the provider documented delivery of that safe storage message.

Discussion

This study demonstrates that screening parents and adolescents for access to firearms in the home and alerting the HCP of those results in the EMR via a BPA leads to

an increase in HCPs addressing the topic of firearm safety, including engaging parents in the discussion of safe storage. Although these results may not be surprising, they are important to recognize and confirm. Pediatricians are tasked with multiple responsibilities related to anticipatory guidance focused on prevention. Since 2012, the AAP has consistently recommended that pediatricians screen for firearm access and counsel caregivers on safe storage.¹⁹ Results from our usual care group—that 25% of HCPs delivered a safe storage message—are commensurate with national surveys that show that 20% of pediatricians “always” identify families with firearms.¹⁵ Our intervention screening for firearm access and notifying the HCPs of the screening answer via the EMR nearly tripled the rate at which HCPs delivered a counseling message. This finding shows that when an HCP is prompted to address a topic such as firearms, they are likely to do so. Our findings are consistent with the previous work, which showed that EMR prompts to address issues such as the presence of future risk for violence perpetration²⁰ greatly increase HCPs addressing violence issues during a clinic visit.

Interestingly, more youth recalled hearing a safe storage message than their parents, in both the intervention and usual care groups. This may reflect that youth incorrectly interpreted that the screening/consent process to participate in the study was considered counseling on safe storage. We also suspect that it is likely that HCPs may have provided some counseling on safe storage without HCPs making notation in the medical record.

Although there appears to be some demographic differences between the groups with the intervention group having more females and whites (though not statistically significant), we do not believe the differences between the 2 groups biased the results. We saw no differences in how counseling was delivered based on sex

or race. This will be important to assess further in large-scale investigations.

This study does highlight certain challenges in conducting research on a topic such as firearm ownership and safety. Enrollment numbers were significantly less than predicted, as only 9.4% of eligible patients indicated firearm ownership, and then only half of those agreed to participate in the study. If only half of firearm owners respond affirmatively to having firearms in the home, then clinicians relying solely on an affirmative answer based on screening would therefore miss the opportunity to deliver a safe firearm storage message for approximately half of firearm owners. One critical and controversial issue facing HCPs, and researchers studying the issue of how the health care environment can be best utilized to decrease youth firearm access by delivering a safe storage message in the clinical setting is whether to screen parents and adolescents for firearm access, and then deliver safe storage counseling based on those results, or to deliver a safe storage message universally, to all parents, independent of using a screening approach. Both AAP²¹ and SAHM²² recommend screening for firearm access as well as counseling on safer firearm storage. Our findings do support that a positive firearm screen embedded in the EMR contributes to both an increase in HCP documentation of delivering a safe storage message and that parents are more likely to report hearing that message.

Therefore, we suggest that HCPs adopt a dual approach: screen for firearm access and deliver a safe storage message to parents regardless of whether they self-report firearm ownership. This approach can lead to a discussion of safe storage with firearm owning parents, but also allow the delivery of a safe storage message universally, whether they own firearms or not.

Although this article does not describe parental behavioral change or intention to change behaviors after delivery of a safe storage message, several other studies support the idea that by counseling parents on safer firearm storage in the health care setting, parents will in fact store their firearms in a safer manner.⁷⁻¹²

Limitations

As noted, our study enrolled fewer families indicating gun ownership than anticipated and only 55% of these families agreed to participate. However, we do not believe this would have biased clinician behaviors. The same clinicians interacted with families assigned to both the usual care group and intervention conditions. It is possible, particularly over time, that they altered their routine behavior for families in the usual care condition, even in the absence of EMR prompts, diminishing the

differences between the intervention and usual care conditions.

The sample size for this study was significantly less than anticipated. Certainly, the numbers of participants reflect that this study should be considered preliminary, which limits generalizability. The sample size did not permit us to distinguish differences between attendings and trainees. However, even the small sample size led to statistically significant conclusions, which suggests that implementation on a larger scale would provide similar results.

Future research on clinician behavior should determine whether using a universal screening approach embedded in the EMR that does not require patients or their parents to reveal firearm ownership leads to delivery of a safer storage message, as well as determining what specific message should be delivered. This strategy has the potential to increase HCP delivery of firearm safe storage messages for youth and parents particularly during annual physical examinations. Examining impacts of these improvements in physician behavior on parental storage behaviors will also be critical in continuously improving the delivery of care to adolescents and their families.

Author Contributions

All three authors- Dr. Sigel, Dr Arredondo Mattson, and Dr. Runyan contributed in the following phases of the study: IRB submission, study conceptualization and design, analyses, manuscript preparation, and review. Additionally, Dr. Sigel provided the educational component to the health care providers, and designed the electronic medical record tools; Dr. Arredondo Mattson, as project director, provided oversight and direction for the research assistant team and data base management.

Declaration of Conflicting Interests

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Ethical Approval

This study was approved by Colorado Multiple Institutional Review Board 13-2829.

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