



# Characteristics and behavioral risk factors of firearm-exposed youth in an urban emergency department

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**Abstract** Assessing firearm access among adolescents with behavioral health risk factors is important for the primary prevention of suicide and interpersonal violence. We describe self-reported firearm access and the associated behavioral risk factors and demographic characteristics in a cross-sectional study conducted in the emergency department of an urban pediatric hospital from June 2013 to June 2014. A total of 2258 adolescents received a behavioral health survey to assess access to firearms inside and outside

the home, mental health symptoms, and risk behaviors. One of 6 patients in our sample (15%) endorsed access to a firearm. Male gender, lifetime alcohol use, lifetime marijuana use, and lifetime other drug use were associated with access. Participants reporting access were more likely to report clinical levels of lifetime suicidality and depression. The odds of current suicidality were highest in those with 24-h access (OR 2.77 CI 1.73–4.46), compared to those who did not endorse access.

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## Introduction

Understanding firearm access is an important first step in preventing violent injury among adolescents, especially given the contribution of firearm violence to mortality and morbidity in this population. Approximately eight children are killed daily by firearms in the United States (Centers for Disease Control and Prevention, 2016a, b). More than half of all firearm homicide deaths occur in adolescents and young adults (Xu & Murphy, 2013). National homicide data indicates that over 70% of homicides are committed with firearms as the primary weapon (Centers for Disease Control and Prevention, 2016a, b). In the city of Philadelphia, 83% of murders committed in the year 2016 were murder by firearm (Philadelphia Police Department, 2016).

Suicides by firearm are also an important public health priority in young patients. Forty-three percent of suicides in children 0–19 years of age have firearms as the primary method (Centers for Disease Control and Prevention, 2016a, b). New research indicates that more than one-third

of firearm deaths among children less than 17 years of age are suicides (Fowler et al., 2017). Tragically, firearm suicides were noted to increase between 2007 and 2014, after a period of steady decline in the preceding several years (Fowler et al., 2017).

Prior research has demonstrated that the lethality of violence is affected by the weapons available at the time that the violence is perpetrated (Zimring, 2004). School-based data suggest that weapon availability and carrying is relatively common. Prior studies have reported that up to 18% of students endorse having carried a gun ever in the past (Brener et al., 2013), and more recent data reveals that almost 5% of all students report carrying a gun at least once in the past 12 months (Youth Risk Behavior Surveillance, 2017). Lowry et al. found that youth who carried weapons were more likely to be in a physical fight than those who did not. Adolescents who carried a handgun were also more likely to have medical care for fight-related injuries (Lowry et al., 1998). Access to firearms has also been shown to be a risk factor for adolescent suicide. Shah and colleagues demonstrated that the majority of patients who died by suicide did so by firearm, and those patients were significantly more likely to have access to a firearm in the home (Shah et al., 2000). However, little work has been done to identify mental health risk factors associated with gun access.

The American Academy of Pediatrics encourages physician to provide counseling around gun safety as a method of gun violence prevention (Dowd et al., 2012). One important setting for this is the emergency room. The emergency department can be a point of contact for at-risk adolescents and can provide an opportunity for preventative measures that have been shown to reduce repeat injury and mortality (Purtle et al., 2013). Prior studies have demonstrated that ED screening has been successful in identifying youth with access to a gun. Loh and colleagues found that in a population of 14–18-year-old patients seen in an urban emergency department, approximately a third reported ready access to a firearm. Risk factors associated with access included age > 16 years, history of substance abuse, history of gun injury, and history of fighting (Loh et al., 2010). Carter et al. (2013) found that among adolescents who presented for assault related injuries, more than 20% reported firearm access; most were male and had a recent history of serious fighting and illicit drug use.

One advantage of identifying youth at risk for gun access in the emergency room is that ED interventions have been shown to be effective. Brief emergency room interventions change risk behaviors associated with violence, including gun violence in particular. Studies using techniques such as motivational interviewing found a reduction in alcohol use, aggressive behaviors (Walton et al., 2010) peer and dating violence (Cunningham et al., 2013) and

even weapon carrying (Zatzick et al., 2014) when performed in combination with pharmacotherapy or cognitive behavioral therapy.

Since effective ED interventions exist, identifying patients with access who may benefit becomes more important. In this study, we demonstrate how a short screen for gun access can be embedded in larger mental health ED screening tool. This allows for evaluation of firearm access risk in the context of other mental health risk factors. In particular we focus on depression, suicidality (including current suicidality), and traumatic stress. We were also interested in if access to a gun in the home or out of the home would yield helpful information to the ED staff when trying to evaluate gun violence potential.

In this study, we describe the frequency of firearm access in our population as well as the demographic and behavioral risk factors associated with access. As compared to prior studies, we focus on depression, suicidality (including current suicidality) and traumatic stress as they relate to access.

## Methods

### Study design

This was an observational cross-sectional study.

### Study setting

This study was performed in the Emergency Department of a freestanding children's hospital located in a large urban area. The hospital is a level 1 Trauma Center with more than 90,000 emergency visits per year and more than 14,000 visits a year for patients 14–19 years of age.

### Study procedures

We collected data for this study using the Behavioral Health Screen for Emergency Departments (BHS-ED), a web-based, self-administered screening tool for all patients 14 years of age and older (Diamond et al., 2010; Fein et al., 2010). The BHS-ED is part of standard care for adolescents in this ED. It is currently only offered to English-speaking patients.

Data collection occurred between June 2013 and June 2014. Patients are approached by medical staff at any point during their visit. Patients who were of the appropriate age and were not precluded from participation based on acuity of illness were given access to a web-based BHS tool using a rolling laptop computer or the desktop computer in each room. The website instantly scores the screen and generates a report for the clinician to review. Initially the report was

printed, but now it goes directly into the EMR. As a part of the screen, adolescents inform providers of whether they are willing to discuss the results in front of their caretakers. If they are not, the providers discuss the results with them confidentially and offer the appropriate referrals.

The BHS-ED is an abbreviated version of a more comprehensive instrument that was designed for use in primary care (Diamond et al., 2010; Fein et al., 2010). The BHS is an assessment tool designed for adolescents in non-psychiatric settings. The items were initially reviewed by a panel of adolescent medicine physicians, pediatricians, child psychiatrists, and child psychologists. Items were based on common risk behaviors (e.g., the Youth Risk Behavior Survey) and psychiatric symptoms (e.g., diagnostic criteria from the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*). Items on the BHS-ED fall into 7 domains: demographics, safety, substance use, depression, suicidality, bullying/violence, and trauma/abuse. The BHS-ED contains 26 core items and 32 follow-up items to positive responses on the core items. The screening tool also contained a brief consent form asking permission to use of de-identified data for research purposes.

Several studies have established psychometric support for many of the scales within the BHS. (Diamond et al., 2010; Bevans et al., 2012). Using 400 patients from primary care the BHS scales were shown to be unidimensional, internally consistent (Cronbach's  $\alpha = .75-.87$ ), and capable of accurately discriminating among adolescents with a range of diagnostic symptoms (Diamond et al., 2010). A yearlong effectiveness study in an emergency department demonstrated that the BHS significantly increased the identification of mental illness or behavioral problems (Fein et al., 2010). Additional studies have shown that the tools can be used to identify and study a host of sub populations that help inform the medial staff about how to use the screening results to better triage patients. For example, a study evaluating bullying and suicidality demonstrated a relationship between the two, especially in the case of verbal bullying. This relationship was worsened by a positive depression screen (Kodish et al., 2016). The screening tool is hosted on an I-cloud based, HIPAA compliant, website run by Medical Decision Logic. More information about the tool, and all the resulting publications can be found at MDlogix.com.

### Demographic information

We collected data on age, race, ethnicity, and gender using patient responses from the BHS and obtained chief complaint data for all adolescent patients seen in the ED in the same time period from the electronic medical record.

### Chief complaint

We abstracted ED visit chief complaint data from the medical chart and classified as (1) trauma/assault (2) psychiatric emergency, and (3) other medical condition. These designations were based on the assigned chief complaint documented in triage, which specify which of these three categories the patient presents with. All patients who were not designated into one of these three categories were classified as “other medical condition.”

### Firearm access

One of the 12 scales in the BHS asks about firearm access. The first questions asks if there is a gun in the home. If the patient says no, they are asked if they could obtain a gun within 24 h. Patients who identify at home access are subsequently asked about the type of gun that is in the home, with a series of available options. The gun access scale is a new addition to the BHS and this is the first paper looking at how youth report on it.

### Fighting behavior

We assessed a history of fighting behavior by whether participants responded “yes” or “no” to the following question: “During the past year, have you had a physical fight with someone who is not your parent or guardian?”

### Bullying

Three questions assessed the participants' history of bullying and related distress: (1) “How often do you feel kids tease you, make fun of you, or ignore you?” (2) “How often do kids physically hurt you or threaten to hurt you?” (3) “How often are you cyber-bullied?” Participants responded on a 3-point scale (Never, Sometimes, Often). Responses were dichotomized (Never or Sometimes/Often) to separate positive from negative responses.

### Depressive symptoms

The BHS depression scale is based on DSM criteria. First, patients are asked two screening questions: mood and anhedonia. If they say yes to either of these questions, they then answer g five items that measured common symptoms of major depression based on DSM criteria. Participants responded on a 3-point scale (never, sometimes, or often) regarding the frequency with which they experienced each symptom during the past 2 weeks. Responses were averaged and dichotomized (minimal/mild or moderate/severe; Diamond et al., 2010).

### Traumatic distress

We asked respondents four questions assessing symptoms of traumatic distress (during past 2 weeks): (1) nightmares or intrusive thoughts, (2) avoidance, (3) hypervigilance, and (4) numbing/dissociation. Participants responded on a 3-point scale (never, sometimes, or often), and mean scores across the four items were dichotomized based on clinical cutoff criteria determined in a prior validation study (Di-[amond et al., 2010](#)).

### Suicidal ideation and/or behavior

We measured suicidality using three items assessing lifetime history and three items assessing current (past week) thoughts about killing self, planning to kill self, and attempting to kill self. If patient said yes to any of the lifetime items, then items about current suicide were asked. Participants who endorsed yes on any of the lifetime questions were coded yes for lifetime suicidality. Participants who endorsed yes on any of the current questions were coded yes for current suicidality ([Bevans et al., 2012](#)).

### Substance use

Alcohol, marijuana, and other substance use (yes/no) were defined by a positive response to questions regarding use of each substance. If patients endorsed lifetime substance use, the BHS then asks how many days of use in the past 30 days.

### Substance use disorder

The new DSM criteria for substance use disorder involve substance use and then any number of 11 impairment symptoms resulting from use. We could not include all 11 impairment items in this short screen. Instead, we have included the four domains that were used in the DSM substance abuse disorder criteria, impairment problems common to adolescents. In the new DSM V criteria, two or more impairments items plus use qualifies for a provisional diagnosis of substance use disorder. We use this to flag a patient that might be having difficulty with substance use and requires further follow up ([American Psychiatric Association, 2013](#)).

### Data analysis

We used descriptive statistics for patient demographics, behavioral risk factors, and firearm access using SPSS Statistics. We used the Chi square test of independence for bivariate analyses and calculated results as unadjusted odds ratios with 95% confidence intervals. To account for

potentially overlapping variance, we tested the variables in a single logistic regression model, though several variables were excluded due to multicollinearity. Backward selection identified the variables that explained the most variance in firearm access. SPSS removed variables based on the probability of the likelihood-ratio statistic, as well as the Akaike information criterion (AIC), to identify the most parsimonious model with the best fit for the data.

### Results

A total of 11,828 eligible patients (age 14–24) presented to the ED during the recruitment period. Of the eligible patients within this period, 8403 were initial ED encounters while 3425 were classified as duplicate visits; only initial encounters were included in the analysis. Of the initial encounters, 26.9% ( $N = 2258$ ) completed the BHS. Of those who completed the BHS, 78.2% ( $n = 266$ ) were in the ED for a medical complaint, 15.8% ( $n = 52$ ) for trauma/assault, and 6.0% ( $n = 26$ ) for a psychiatric emergency ([Table 1](#)). The BHS sample had lower rates of black patients, male patients, trauma/assault victims, and higher rates of patients with a psychiatric complaint than the sample of patients that were not screened.

One-sixth ( $n = 344$ , 15.2%) of the sample screened reported that they had access to a firearm. The overall rates of other behavioral risk factors in our sample are found in [Table 2](#).

In the bivariate analysis, participants who reported access to a firearm differed significantly in a number of behavioral risk factors. Those with access were more likely to be male and had higher rates of reported suicidal ideation and/or behavior, substance use and impairment, history of physical fighting or physical bullying, and clinically significant levels of depression or traumatic distress ([Table 3](#)). The strongest associations were for the substance use variables; for example, those patients who reported a lifetime history of other drug use had more than three times the odds of having access to a firearm (OR: 3.55; 95% CI 2.32–5.43). These associations are even more notable in patients with 24-h access. Participant characteristics were entered as predictors of firearm access in a binary logistic model predicting participants' access to a firearm. [Table 4](#) reports the adjusted odds ratios for the full model, which includes all the variables as the predictors.

A reduced model with the lowest AIC was identified using backward selection and determined to be the best fit for the data. When adjusting for the other predictor variables, the reduced model shows that males were more likely to have access to a firearm, as were participants who had a history of alcohol use, lifetime history of marijuana use, or a lifetime history of other drug use. Importantly,

**Table 1** Comparison of ED patients that completed the BHS to those that did not complete the BHS

	% Non-BHS patients with this characteristic (n = 6145)	% BHS Participant with this characteristic (n = 2258)	$\chi^2$
<b>Demographics</b>			
Age ( $\geq 18$ )	8.9	9.7	1.0
Race (African–American)	58.4	55.9	512.47***
Race (White)	33.4	31.3	3.17 <sup>†</sup>
Hispanic	4.9	5.8	2.63
Gender (male)	49.5	30.9	219.37***
<b>Chief complaint</b>			
Trauma/assault	28.1	15.8	161.06***
Psychiatric concern	1.5	6.0	101.41***
Other medical concern	70.3	78.2	75.59***

<sup>†</sup> $p \leq .1$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

**Table 2** Rates of behavioral risk factors (N = 2258)

	<i>n</i>	% of sample
<b>Firearm access</b>		
In the home	344	15.2
Access within 24 h	160	7.1
	184	8.1
<b>Substance use</b>		
Lifetime history alcohol	566	25.1
Lifetime history marijuana	437	19.4
Lifetime history other drugs	99	4.4
Current alcohol use	265	11.7
Current marijuana use	254	11.2
Substance-related impairment	128	5.7
<b>Fighting behavior</b>		
Physical fight	489	21.7
<b>Bullying</b>		
Verbal	583	25.8
Physical	159	7.0
Cyber	182	8.1
Depression (moderate/severe)	856	37.9
Traumatic distress	857	38.0
<b>Suicidal ideation and/or behavior</b>		
Lifetime	456	20.2
Current	9	5.7

patients who reported clinical levels of depression (OR 1.49 95% CI 1.12–1.99) and both lifetime and current suicidality had modestly increased odds of firearm access (OR 1.5 95% CI 1.05–2.15 and OR 1.66 95% CI 1.00–2.77, respectively).

A little over half (53%) of those participants who reported access to a firearm reported that they did not have one in the home but could obtain one within 24-h. Those who had 24-h access were more likely to endorse alcohol and marijuana use, substance related impairment, fighting

behavior, depression, traumatic stress, depression, and current suicidality (Table 3). While overall, white patients had higher reported rates of home firearm access (OR 2.46 CI 1.78–3.41), African American patients were more likely to report access to firearms within 24 h (OR 1.58 CI 1.15–2.16). Patients presenting for trauma or assault related complaints were more likely to report that they could obtain a firearm within 24 h (OR 1.61 CI 1.09–2.38) than to report that they had in-home access (OR 0.74 CI 0.43–1.26).

**Table 3** Percentages of participants with any access to firearms (in the home or within 24 h) (n = 344), those who could obtain access to firearms within 24-h (n = 184), and those with in-home access to firearms (n = 160). Comparison group for all categories are participants without any firearm access (n = 1891)

	Firearm access (%)	OR (95% CI)	Access within 24 h (%)	OR (95% CI)	Access in the home (%)	OR (95% CI)
<b>Demographics</b>						
Age ( $\geq 18$ )	13.7	0.99 (0.7–1.4)	15.2	1.12 (0.7–1.7)	11.9	0.84 (0.5–1.4)
Race (African–American)	50.6	0.90 (0.7–1.1)	64.1	1.58 (1.2–2.2)**	35.0	0.48 (0.3–0.7)***
Race (White)	30.8	1.07 (0.8–1.4)	13.6	0.38 (0.3–0.6)***	50.6	2.46 (1.8–3.4)***
Hispanic	11.9	1.39 (0.96–2.0) <sup>†</sup>	14.9	1.82 (1.2–2.8)**	8.4	0.95 (0.5–1.7)
Gender (male)	40.4	1.58 (1.2–2.0)***	42.9	1.75 (1.3–2.4)***	37.5	1.39 (1.0–1.9) <sup>†</sup>
<b>Chief complaint</b>						
Trauma/assault	15.1	1.18 (0.9–1.6)	19.6	1.61 (1.1–2.4)*	10.0	0.74 (0.4–1.3)
Psychiatric concern	7.6	1.35 (0.87–2.11)	7.6	1.36 (0.8–2.4)	7.5	1.34 (0.7–2.5)
Other medical concern	77.3	0.79 (0.6–1.0) <sup>†</sup>	72.8	0.62 (0.4–0.9)**	82.5	1.09 (0.7–1.7)
<b>Substance use</b>						
Lifetime history alcohol	40.4	2.35 (1.8–3.0)***	45.7	2.91 (2.1–4.0)***	34.4	1.81 (1.3–2.6)**
Lifetime history marijuana	33.4	2.46 (1.9–3.2)***	45.1	4.02 (2.9–5.5)***	20.0	1.22 (0.8–1.8)
Lifetime history other drugs	10.8	3.55 (2.3–5.4)***	12.5	4.21 (2.5–7.0)***	8.8	2.83 (1.6–5.2)***
Current alcohol use	18.6	1.90 (1.4–2.6)***	21.7	2.30 (1.6–3.4)***	15.1	1.48 (0.9–2.3) <sup>†</sup>
Current marijuana use	20.1	2.28 (1.7–3.1)***	28.1	3.54 (2.5–5.1)***	11.3	1.15 (0.7–1.9)
Substance-related impairment	11.3	2.59 (1.7–3.9)***	16.8	4.10 (2.6–6.4)***	5.0	1.07 (0.5–2.2)
<b>Fighting behavior</b>						
Physical fight	29.7	1.68 (1.3–2.2)***	41.5	2.82 (2.1–3.9)***	16.3	0.77 (0.5–1.2)
<b>Bullying</b>						
Verbal	26.2	1.03 (0.8–1.3)	27.7	1.11 (0.8–1.6)	24.4	0.94 (0.6–1.4)
Physical	9.9	1.60 (1.1–2.4)*	13.0	2.19 (1.4–3.5)**	6.3	0.98 (0.5–1.9)
Cyber	7.6	0.92 (0.6–1.4)	8.2	1.00 (0.6–1.7)	6.9	0.83 (0.4–1.6)
<b>Depression</b>						
Depression	48.8	1.72 (1.4–2.2)***	59.8	2.68 (2.0–3.7)***	36.3	1.02 (0.7–1.4)
<b>Traumatic distress</b>						
Traumatic distress	44.5	1.38 (1.1–1.7)**	56.0	2.19 (1.6–3.0)***	31.3	0.78 (0.6–1.1)
<b>Suicidality</b>						
Lifetime no current	20.6	1.70 (1.3–2.3)***	20.1	1.65 (1.1–2.4)*	21.3	1.76 (1.2–2.6)**
Current	9.3	1.90 (1.3–2.9)**	13.0	2.77 (1.7–4.5)***	5.0	0.97 (0.5–2.0)

23 patients did not respond to the question about gun access

<sup>†</sup> $p < .1$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

## Discussion

This study demonstrates the notable frequency of firearm access among adolescents in an urban pediatric emergency department as well as the behavioral risk factors associated with such access. In this study sample of pediatric ED patients, 15% reported that they either have a firearm in their home or could obtain one within 24 h. More patients reported 24-h out-of-home access. Prior ED-based studies found possession rates ranging from 7% to as high as 33% (Loh et al., 2010; Carter et al., 2013; Walton et al., 2009;

Cunningham et al., 2010). In our sample population, the odds of reporting access for male patients was greater (1.58 CI 1.24–2.00), consistent with the finding that males seen in emergency department visits are more likely than females to have access to firearms (Loh et al., 2010; Carter et al., 2013; Cunningham et al., 2010).

Our study also demonstrated significant behavioral risk factors associated with firearm access. The rates of fighting behavior, depression, traumatic distress, and bullying victimization were also significantly higher in participants who had access to firearms compared with those who did

**Table 4** Adjusted odds ratios (95% CI) for multivariate logistic regression predicting firearm access

	Complete model	Reduced model
<b>Demographics</b>		
Age ( $\geq 18$ )	0.96 (0.66–1.37)	
Race (African–American)	1.22 (0.82–1.81)	
Race (White)	1.44 (0.94–2.21) <sup>†</sup>	
Hispanic	1.51 (0.96–2.40) <sup>†</sup>	
Male gender	1.66 (1.28–2.16) <sup>***</sup>	1.70 (1.31–2.20) <sup>***</sup>
<b>Chief complaint</b>		
Trauma/assault	0.93 (0.64–1.35)	
Psychiatric concern	1.06 (0.61–1.84)	
<b>Substance use</b>		
Lifetime history alcohol	1.95 (1.35–2.81) <sup>***</sup>	1.71 (1.26–2.32) <sup>**</sup>
Lifetime history marijuana	1.29 (0.80–2.08)	1.42 (1.02–1.97) <sup>*</sup>
Lifetime history other drugs	1.81 (1.10–3.00) <sup>*</sup>	1.81 (1.11–2.94) <sup>*</sup>
Current alcohol use	0.74 (0.47–1.17)	
Current marijuana use	1.20 (0.71–2.02)	
Substance-related impairment	1.00 (0.60–1.68)	
<b>Fighting behavior</b>		
Physical fight	1.23 (0.91–1.66)	
<b>Bullying</b>		
Verbal	0.76 (0.55–1.06)	0.76 (0.56–1.02) <sup>†</sup>
Physical	1.40 (0.84–2.34)	
Cyber	0.69 (0.41–1.15)	
Depression	1.51 (1.11–2.05) <sup>**</sup>	1.49 (1.12–1.99) <sup>**</sup>
Traumatic distress	0.97 (0.72–1.29)	
<b>Suicidality</b>		
Lifetime no current	1.45 (1.01–2.09) <sup>*</sup>	1.50 (1.05–2.15) <sup>*</sup>
Current	1.65 (0.93–2.93) <sup>†</sup>	1.66 (1.00–2.77) <sup>†</sup>

<sup>†</sup> $p < .1$ , <sup>\*</sup> $p < .05$ , <sup>\*\*</sup> $p < .01$ , <sup>\*\*\*</sup> $p < .001$

not. Adolescents with lifetime history of alcohol use, past and current marijuana use, and substance-related impairment had more than twice the odds of having access to firearms as those with no risk behaviors. Youth with lifetime history of other drug use had over three times the odds of having access to a firearm than those without other drug use history. Of greatest concern was the finding that those with lifetime suicidality were more likely to endorse access to firearms, and firearm access was even more likely for patients with *current* suicidality.

Prior studies have demonstrated that among adolescents, substance use correlates with increased odds of firearm homicide (Hohl et al., 2017; Carter et al., 2017). Alcohol consumption around acts of firearm violence including homicide, suicide, and accidental death have been demonstrated in multiple studies, indicating that alcohol use and specifically alcohol abuse is associated with both owning and using firearms. Risk factors such as alcohol use and firearm violence may also be related through additional environmental factors such as poverty or exposure to

challenging social circumstances (Branas et al., 2016). The correlation between drug and alcohol use and firearm access may be stronger outside of the home because “street” access may be more indicative of a challenging social environment than guns that are secured in the home. Moreover, we know that exposure to marijuana and prescription drugs (in addition to alcohol) has been shown to be associated with days of interpersonal conflict in longitudinal studies of high-risk adolescents (Carter et al. 2017). These risk factors work in concert, resulting in a higher risk of injury or death due to firearm violence. This underscores the value of screening for behavioral risk factors along with gun access. These findings do not establish causality, but demonstrate that, concerning, youth with behavioral problems often have access to a gun.

These findings have important implications for the medical staff. First, it is important to note that patients will report gun access as part of routine medical screening (rather than in the context of a research study). We recommend these questions be included in a broader mental

health screen. Putting gun access into a broader risk profile (i.e., depression, suicidal ideation) can help assess the need for more urgent attention.

Medical providers may also want to evaluate if the access to a gun is in the home or out of the home. More patients reported they could obtain a firearm within 24 h outside of the home in our sample. Even more concerning, youth with access to guns out of the home, also reported more behavioral risk factors. Formal recommendations around safe storage of home guns are already an important part of pediatric anticipatory guidance (Shah et al., 2000; Dowd et al., 2012). However, protecting-high risk patients who have out-of-home access poses different challenges, and highlights the importance of more comprehensive approach to access prevention in this population. Brief interventions that address motivations for obtaining firearm access among adolescents and help identify alternate methods of conflict resolution or self-protection based on those motivations could lead to behavior change. Eighty-eight percent of our sample answered “yes” to the question “do you think it is a good idea to ask these questions”. This implies that patients are open to discussing these topics.

In addition, more policy-based initiatives that place the onus on firearm owners to safely secure firearms and account for lost or stolen weapons may help to limit the risk of inappropriate access among the adolescents and children. Child access prevention laws, or CAP laws, mandate the safe storage of firearms by their owners. This is a policy initiative that has the potential to affect both home access and out-of-home access.

These results have several important implications. Ready firearm access, both in the home and out of the home, poses a threat to patients with unidentified or untreated behavioral health problems. Furthermore, the recognition of patients’ histories of suicidality, and most importantly, active suicidality, in patients with ready access provides an opportunity to prevent devastating and irreversible outcomes. One-fifth of adolescents with firearm access in our population endorsed a history of suicidality. Most teens that attempt suicide with firearms use weapons owned by their families (Kellerman et al., 1992), and among our patients this was only one source of access. Of note, fourteen states have enacted extreme risk protection order, or ERPO, legislation. This allows family, law enforcement, or healthcare providers to petition to remove firearms from the possession of an owner posing an imminent risk to themselves or others. Although these laws pertain to the owner of the firearm, who is usually an adult, there are significant implications for others who might be at risk in the home. This lays the groundwork for protection from lethal means in a time of crisis.

## Limitations and future directions

Our study has several limitations. First, a large portion of the available patients did not take the screen and thus were not included in the analysis. Those screened consisted of more females and non-trauma patients and less black patients. They also were more likely to have a psychiatric chief complaint. However, because psychiatric chief complaints represented a relatively small portion of the overall sample this was unlikely to influence the results. Prior research (Carter et al., 2013) has indicated that male adolescents and trauma patients are more likely to have other behavioral risk factors, and so our results would likely be strengthened rather than weakened by a more balanced inclusion of these patients.

Still, the small portion of the overall available patients may limit the generalizability of our findings. Acuity of illness, language barriers, developmental ability, or refusal are important contributors to missed screens. The integration of screening into work flow also posed challenges in the early stage of this study. Staff resistance to mental health screening has decreased with intentional efforts to improve practices since the time of this study, and screening rates are now at 60% of eligible patients. While universal screening might be ideal for clinical and research purpose, this may be difficult to achieve in a busy urban emergency room setting. We would also like to strengthen the psychometric validation of the study tools, and the firearm scale in particular, going forward. The succinct nature of the firearm questions is an attempt to balance depth with brevity, while still helping providers start difficult conversations with high-risk patients.

## Conclusion

Our results demonstrate that one out of every six adolescents screened in a pediatric ED endorsed access to firearms. Patients who reported concerning behavioral risk factors, including substance abuse and suicidality, were more likely to also report the ability to access to a gun either in their home or within 24 h. Our findings highlight the importance of emergency department screening for firearm access and behavioral health issues. Brief interventions for patients identified as high risk could lead to behavior changes that improve outcomes and, in the case of actively suicidal patients, save lives. The emergency room visit presents an opportunity to perform motivational interviews among at risk adolescents, while patients await medical treatment. Further study is needed to establish and refine comprehensive approaches to firearm safety coun-

selling for ED patients with both home and out-of-home gun access.

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### Compliance with ethical standards

**Conflict of interest** The Behavioral Health Screening tool is owned by The Children's Hospital of Philadelphia and licensed to Medical Decision Logic, Inc., a health science informatics and computer science engineering company. Drs. Diamond and Fein might 1 day receive a small royalty payment for their part in developing the tool. Dr. Abaya and the other coauthors do not report financial interests or potential conflicts of interest.

**Human and animal rights and Informed consent** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. This article does not contain any studies with animals performed by any of the authors.

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